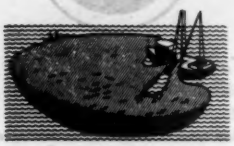
FISHERY MARKET NEWS

MAY 1945 - SUPPLEMENT



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EXPERIMENTAL PURSE SEINE FISHING FOR MENHADEN WITH THE JEFF DAVIS

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FISHERY MARKET NEWS

A REVIEW OF CONDITIONS AND TRENDS OF THE FISHERY INDUSTRIES

PREPARED IN THE DIVISION OF COMMERCIAL FISHERIES

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The general plan for the study was conceived and initiated by Mr. Roger W. Harrison, formerly Chief, Technological Section, Division of Fishery Industries, Fish and Wildlife Service, Washington, D. C.

Mr. Robert O. Smith, of the Office of Fishery Coordination at Jacksonville, Florida, was largely responsible for the completion of negotiations between the Fish and Wildlife Service and Mr. Burgman. He also rendered valuable assistance during the progress of the work.

Mr. Tracy J. Corbett, of the Nassau Fertilizer and Oil Company, Fernandina, Florida, was most cooperative during the course of the project and provided all possible assistance.

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Supervision of the specialized construction of the vessel and the procurement of special equipment, together with the direction of the experimental activities were handled by Carl B. Carlson, Fishery Engineer, Fish and Wildlife Service. Kenneth P. Foster, Boatswain of the United States Coast Guard Reserve, was detailed as Mate and assisted in the project.

EXPERIMENTAL PURSE SEINE FISHING FOR MENHADEN WITH THE JEFF DAVIS

By

Carl B. Carlson* and Kenneth P. Foster**

INTRODUCTION

Background and Purpose of Investigation

The known range of the menhaden, Brevoortia tyrranus, extends from Nova Scotia to Brazil, while profitable fisheries for this species exist in Mississippi, Florida, North Carolina, Virginia, Delaware, New Jersey, and New York. The annual production of menhaden is nearly four times that of any other single species of fish taken off the Atlantic and Gulf Coasts of the United States. The average catch of 650 million pounds represents about one-third of the entire production of all fisheries of that large area. If this marine resource were fully utilized even larger quantities of menhaden could be landed each year for processing into fish meal for feeding purposes and fish oil for feeding and industrial uses. The catch, however, has been limited by the characteristics of the vessels and methods regularly employed in this fishery. The usual menhaden seiner is a comparatively large vessel, requiring a crew of 22 men, and therefore it is suitable only when there is an abundance of large schools of menhaden. The wartime increased demand for fish reduction-plant products further emphasized the need for improved or new methods of catching menhaden. Among the proposals for more effective use of the available manpower and equipment, the most feasible appeared to be (1) the introduction of Pacific Coast pilchard seining methods and (2) the adaptation of shrimp vessels for part-time menhaden seining.

The need for small vessels capable of profitable menhaden fishing was further emphasized early in 1943 by the establishment of a small experimental cannery at Fernandina, Florida, in which the Stokely Foods Incorporated hoped to develop methods for canning menhaden. However, most of the fish landed at Fernandina were found to be unfit for canning purposes. Several factors, such as the prevailing high temperatures, excessive pressure on the fish while in the hold, and the unusually rapid belly deterioration (possibly caused by the nature of the feed in this locality), were responsible for the poor quality of the raw fish. In an attempt to land better quality fish, a small shrimper was outfitted with a small Pacific type purse seine. During the period this vessel was in operation the fishing results showed some promise, but the fish taken were too small for canning, and the vessel, because of its limited capacity, could not operate profitably at reduction plant prices.

In the past the principal deterrents to the experimental trial of Pacific Coast pilchard seining methods have been the lack of experienced fishery engineers and the reluctance on the part of fishing concerns to gamble the large amount of money required to build, or purchase and transfer, a pilchard-type seiner and then finance its trial operations. However, in 1943, the Fish and Wildlife Service and Mr. Burgman, together with various members of the fishing industry, concluded that a shrimp vessel, modified along the lines of a Pacific Coast pilchard seiner, could be profitably operated in the menhaden fishery, especially if it would also enter other local fisheries when menhaden were not available. It was believed that food fish of various species were available in the waters off the South Atlantic and Gulf States in sufficient quantities and under conditions which would render profitable their capture with purse seines; furthermore, in the South Atlantic and Gulf areas there were available a large number of shrimp vessels of more than 60 feet in length which, with some modification, would be suitable for operating seines. Concluding that the development of a vessel with equipment capable of efficient operations in the menhaden, food fish and shrimp fisheries would materially benefit the industry and the area, plans were formulated for conducting an exploratory and experimental fishing investigation. In September of 1943 an agreement was reached between the Burgman Tractor-Equipment Company and the Fish and

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Wildlife Service. The former made available—for the period January to June 1944—the vessel Jeff Davis, a small modern shrimp trawler, modified and equipped to fish with a Pacific type purse seine. The Service furnished the necessary technical personnel to supervise the specialized construction and modification of the vessel in the latter part of 1943, and to direct the experimental fishing operations in 1944.

Plan and Scope

The principal features of the original plan for this investigation were:

(1) On the basis of all available technical experience, to design, construct, and equip a multiple purpose vessel, capable of entering the fisheries for menhaden, shrimp, mackerel, and other food fishes occurring along the Atlantic and Gulf Coasts, especially in the vicinity of Fernandina, Florida.

(2) To conduct an experimental investigation using this vessel to fish for menhaden according to the Pacific Coast pilchard purse seining methods—ascertaining whether the method is suitable and, if so, determining any required modifications in vessel or gear design or operational procedure.

(3) To perform an exploratory and experimental survey of the South Atlantic coastal waters to determine which other fishery resources could be profitably exploited by a modified "shrimp trawler-purse seiner".

In planning this investigation it was always realized that the pilchard purse seine could not be adopted in every detail by the menhaden fishery. The Pacific type purse seine was designed primarily for fishing in relatively deep water, while off Florida the menhaden are taken in shallow coastal waters. The pilchard and the menhaden are similar in some characteristics, but their reactions, upon being encircled with a net, are quite different. In addition, of course, the water temperatures and currents off California and off Florida are not identical. Yet it was hoped that by modifying the Pacific methods it would be possible to develop an efficient procedure, suitable for taking menhaden, but requiring no more than 11 men to handle the vessel and gear.

The experimental vessel, Jeff Davis, 65 tons gross and 31 tons net, powered with a 115 horsepower, medium-speed, full-Diesel engine, was completely outfitted for fishing operations by the first part of January, 1944. The vessel was built along the lines of a typical 65 foot shrimp trawler and furnished with the necessary mechanical equipment and accommodations to render her suitable for purse seining. Further details on the vessel and gear employed are given in the section entitled "Equipment and Methods".

Some time prior to the initiation of this project, the State of Florida temporarily suspended the application of legislation prohibiting the use of purse seines in taking food fish. Consequently it was planned that the vessel would engage in the winter Florida Key fishery, attempting to follow the Spanish mackerel migration northward and then fish for menhaden during April, May, and June. However, shortly before the outfitting of the vessel was finished, the State rescinded this suspension. Therefore an alteration of plans was necessary, for it was believed that there would be little value realized from research in an area where the results could not legally be put to commercial use. It was decided to substitute a search for food fish outside of Florida State waters (3 leagues—10½ miles—off shore) and also along the Georgia and Carolina coasts, where no restrictions were in effect. In accordance with the original plan, the vessel engaged in menhaden fishing when markets for the catch became available. The principal area of operation and the locations of various reference points are shown in Figure 1.

The month of January was spent in searching for Spanish mackerel and menhaden from the St. Simon Sound in Georgia to New Smyrna Beach in Florida. Operations were temporarily abandoned in February as a market for menhaden was not available at that time and there appeared to be little prospect of taking mackerel. During March and most of April, the search for mackerel was continued and considerable time was devoted to hand lining for reef fishes to partially defray the operating expenses of the vessel. This combination permitted running along off shore in the early morning and late evening, thus spending the most favorable hours of the day in searching for schools of food fishes.

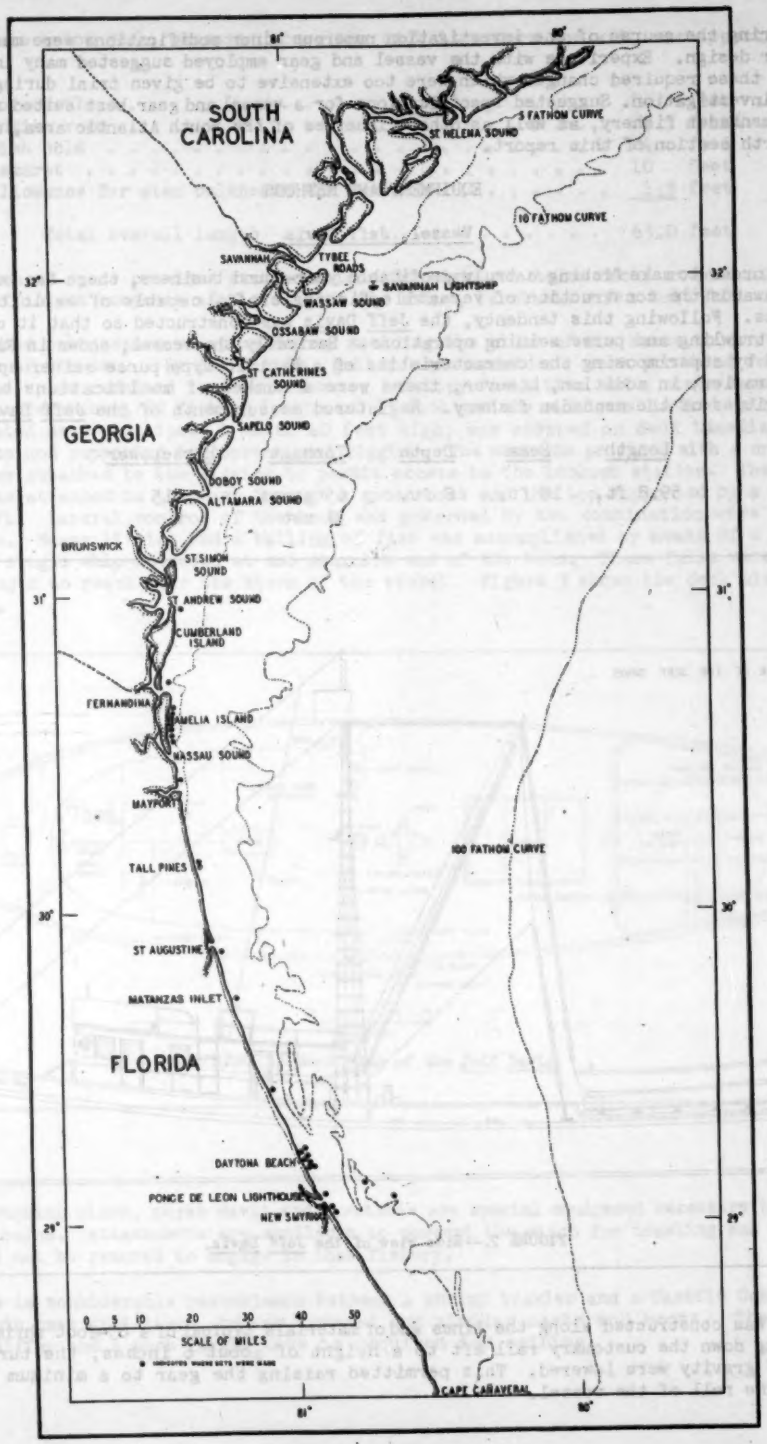

FIGURE 1.--Area of Operations.

During the course of the investigation numerous minor modifications were made in vessel and gear design. Experience with the vessel and gear employed suggested many improvements; some of these required changes which were too extensive to be given trial during the period of the investigation. Suggested specifications for a vessel and gear best suited for engaging in the menhaden fishery, as well as other fisheries of the South Atlantic area, are given in the fourth section of this report.

EQUIPMENT AND METHODS

Vessel, Jeff Davis

In order to make fishing a truly profitable year-round business, there has been a recent trend towards the construction of versatile fishing craft, capable of exploiting several fisheries. Following this tendency, the Jeff Davis was constructed so that it could engage in both trawling and purse seining operations. Basically the vessel, shown in Figure 2, was designed by superimposing the characteristics of a Pacific type purse seiner upon a modern shrimp trawler; in addition, however, there were a number of modifications based on the peculiarities of the menhaden fishery. Registered measurements of the Jeff Davis were:

Length	Beam	Depth	Tonnage	Horsepower
59.8 ft.	18 ft.	8 ft.	65 gross 31 net	115

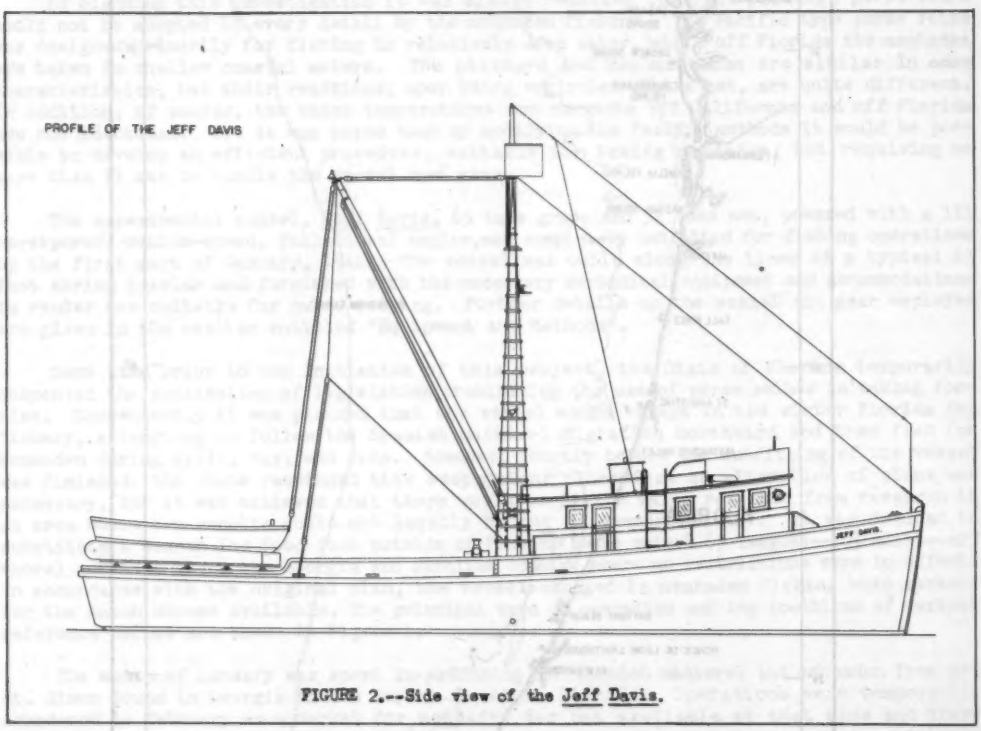

FIGURE 2.--Side view of the Jeff Davis.

The hull was constructed along the lines and of materials typical of a 65-foot shrimp trawler. By cutting down the customary rail aft to a height of about 6 inches, the turntable and center of gravity were lowered. This permitted raising the gear to a minimum height and reduced the roll of the vessel.

The space below deck, measured along the deck line fore and aft, was apportioned as follows:

Forecastle	16 feet
Engine room	13.5 feet
Fish hold	24 feet
Lazaret	10 feet
Allowance for stem bulkheads and transom	1.5 feet
Total overall length	65.0 feet

This division of space provided accommodations for eight men below deck; an adequate engine room and sufficient buoyance aft to support the seine, turntable and a hold full of fish.

Increased cabin space was provided by moulding the sides of the house to conform with the outline of the deck. By doing this, galley accommodations were provided for 10 men and adequate space remained for a wheelhouse, lavatory facilities and a state room for two persons. The deckhouse, 20 feet in length and 15 feet maximum width, was located well forward and terminated near midships. A mast, 40 feet high, was stepped on deck immediately aft of the house and supported by conventional rigging. The mast was provided with a crows nest and ratlines attached to the rigging to permit access to the lookout station. The base of the boom was attached to the mast through a goose-neck and the top supported by a 4 strand topping lift. Lateral control of the boom was governed by two combination wire and rope tackle guys. Heavy lifting and a bailing of fish was accomplished by means of a 4 strand tackle and single whip attached at and near the end of the boom. These falls were of sufficient length to reach over the stern of the vessel. Figure 3 shows the deck plan of the Jeff Davis.

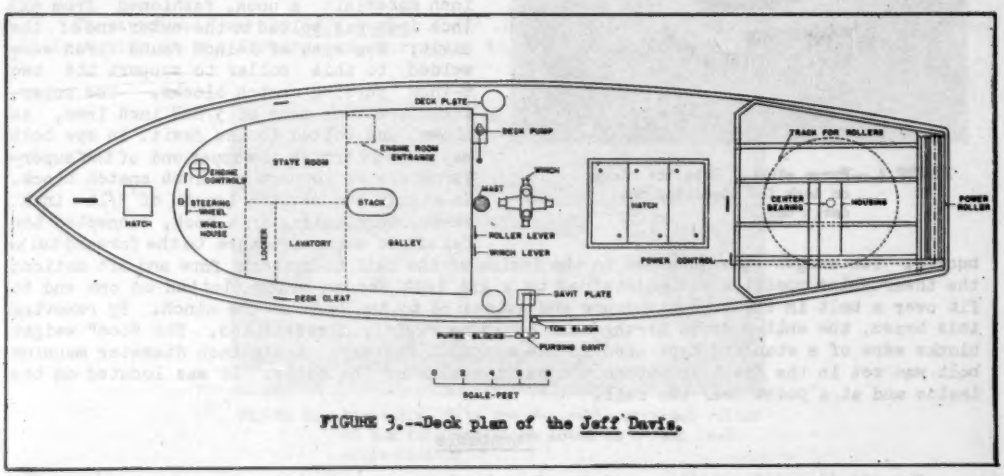

FIGURE 3.--Deck plan of the Jeff Davis.

The pursing winch, purse davit and turntable are special equipment necessary to operate the purse seine. Attachments are available to convert the winch for trawling and the turntable need not be removed to engage in that fishery.

There is considerable resemblance between a shrimp trawler and a Pacific Coast seiner in that both have full lines, houses forward and similar masts and booms. The types of activity differ and a much larger crew is required for seining.

Purse Winch

The winch, which is shown in Figure 4, was a type commonly used on the Pacific Coast and consisted of a hollow frame or housing which supported a power driven shaft on which 2 large drums and 2 small drums are mounted. Internally the shaft supported a sprocket gear for driving and a ratchet wheel for preventing backward motion of the gypsies. Power was transmitted from the main engine to the winch by a disk clutch, a system of sprocket gears, 1-inch-pitch roller chain and 1 11/16-inch-diameter shafting. (Cf. Figure 7). The shafting was supported by the deck beams and the immediate chain driving the winch passed through the deck and inside the housing. A distance of eighteen inches was allowed between the winch and the mast to allow passage and working space. The winch was located in a near midships position to prevent either the stern or the bow of the vessel being unequally drawn into the net while pursing.

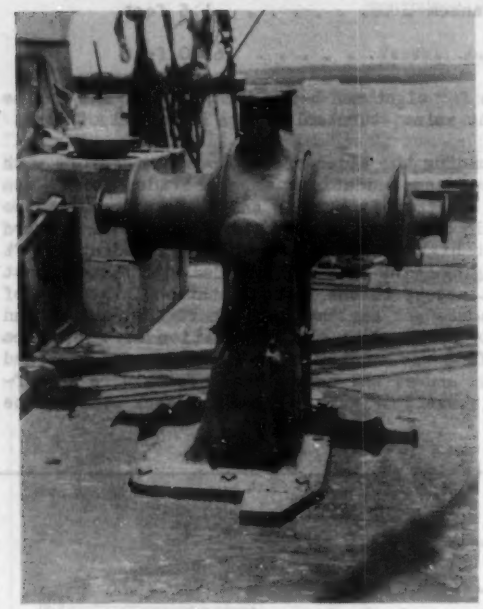

FIGURE 4.--Purse winch. Note the block on deck for steadying the davit bar.

Pursing Davit

The pursing davit, shown in Figure 5, was similar to that used on the Pacific Coast, except for the superstructure, which was added to handle the 600 pound "tom" weight. The wood portion of the davit was made of 4x6 inch material; a hook, fashioned from ½x3 inch iron was bolted to the outer end of the davit; two eyes of 1-inch round iron were welded to this collar to support the two 8-inch pursing snatch blocks. The superstructure was made of 5/8x2 inch iron, as shown, and bolted to the davit. An eye bolt was passed through the upper end of the superstructure to support a 6-inch snatch block. To steady the davit a length of 3/16 inch chain, terminating in a hook, connected the top of the superstructure to the forward turnbuckle. Two wedges were attached to the inside of the rail to restrain fore and aft motion; the thwartships position was maintained by a 4x4 inch wooden brace slotted on one end to fit over a bolt in the superstructure and extending to the base of the winch. By removing this brace, the entire davit arrangement could be rapidly disassembled. The "tom" weight blocks were of a standard type used in the menhaden fishery. A 3/4 inch diameter machine bolt was set in the davit to attach the davit straps of the seine. It was located on the inside and at a point near the rail.

Turntable

Essentially, a turntable consists of a platform, or "bottom", with raised sides and a power roller. Its function is to carry the seine and provide an efficient means for setting and hauling gear. The table is located on the stern and is slightly smaller but similar in form to the outline of the after deck. It is free to rotate in a complete circle, but the main positions are the running or setting position, in which the power roller is directly over the stern, and the hauling position, which places the roller over the side of the vessel. Rotation of the table is achieved by mounting it on a set of metal rollers and a center bearing which also prevents the table from sliding off the rollers. An iron ring attached to the under side of the table acts as a run for the supporting rollers. Rope straps are provided at the corners of the table to permit engaging a line to the winch and thus apply power to turn the table when loaded with the net.

FIGURE 5.--Pursing davit and "ton" weight.

The turntable on the Jeff Davis, shown in Figures 2, 3, 6, and 15, was 15 feet long and 15 feet wide at the forward end, narrowing to 10½ feet at the roller or after end.

FIGURE 6.--Turntable. Note the removable vertical roller at the far left which acted as a fair lead while hauling.

Tightly fitted planking 2 inches thick was used for the bottom, and the sides were made of 3½ inch material. The roller end of the platform was reinforced with a 6x6-inch brace, while four braces, each 4x4 inches, were laid fore and aft on the bottom planking and mortised into both the forward side and the roller end brace. The forward side was 10 inches high, while the outer two sides increased from 10 to 18 inches at the after end to accommodate a power roller 17 inches in diameter. These outer sides extended 18 inches beyond the bottom and were rounded to form an 18 inch diameter semicircle, thereby eliminating corners which might catch the net. Holes to accommodate the bearings for the roller were cut in such a location as to center the roller in the semicircle.

The power roller consisted of a wooden frame and face built around a 1½ inch shaft, as shown in Figure 7. The roller frame was constructed by mounting three octagonal shaped

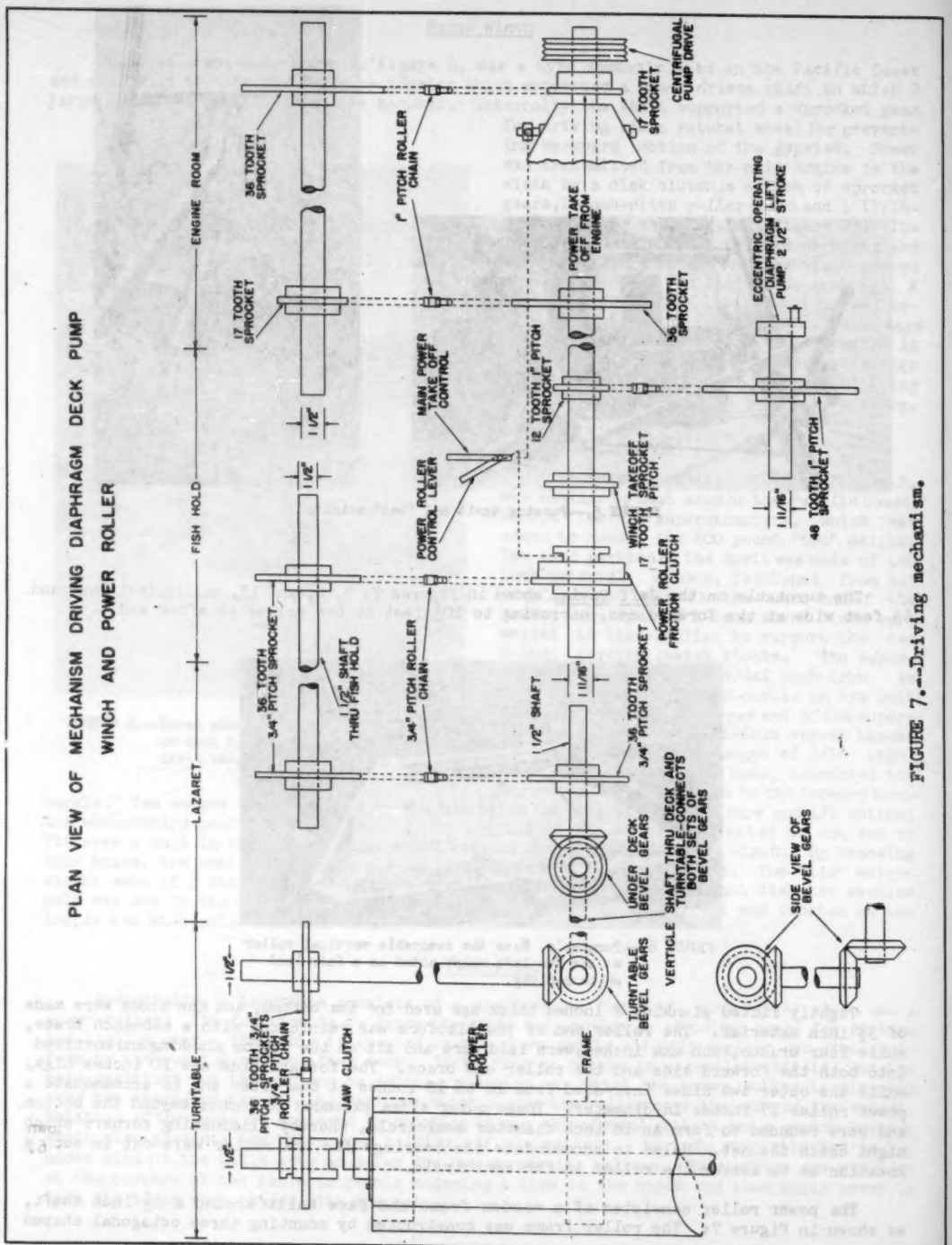

FIGURE 7.--Driving mechanism.

blocks on the shaft, and the face was completed by fastening 2 inch planks to the eight sides of the frame. Ropes were stapled in the resulting V-shaped openings--between these planks--to increase the friction between the net and roller while hauling. The wood portion of the roller was made 9 inches shorter than the inside width of the table to allow space for the driving sprocket gear and the idling jaw clutch. Power operation and free turning of the roller was achieved by boring the sprocket gear to turn freely or to slide on the power-roller shaft and engage a jaw clutch. The rod controlling the gear position was extended to the forward end of the table and terminated in the lever shown in the lower right corners of both Figures 3 and 6.

Mechanical force to drive the power roller was obtained through a 3 horsepower friction clutch mounted on the winch line shaft and directed to the roller through a system of sprocket gears, 3/4-inch-pitch roller chain, 1½ inch shafting, and bevel gears as shown in Figure 7. A roller chain transferred power from the clutch to a shaft running along the hold deck beams and into the lazaret, where a second chain activated a set of bevel gears, located below decks at the center line of rotation of the turntable. This set of gears, set in a cast frame, transferred rotation from a horizontal fore and aft line to a vertical direction through the deck, center bearing and turntable (see Figure 8). A similar set of gears located on top of the table permitted transfer of mechanical force to the side of the table and thence to the roller by means of another chain. All mechanism on top of the table was enclosed to prevent tearing of the net and a sheet metal guard, shown in Figures 6 and 8, was fitted over the driving gear on the roller shaft. The top of the wood housing was removable and a hole was provided in the sheet metal to enable servicing the equipment. The power roller friction clutch was adjusted to permit slippage in order to avoid damaging the equipment if the seine jammed between the roller and the table.

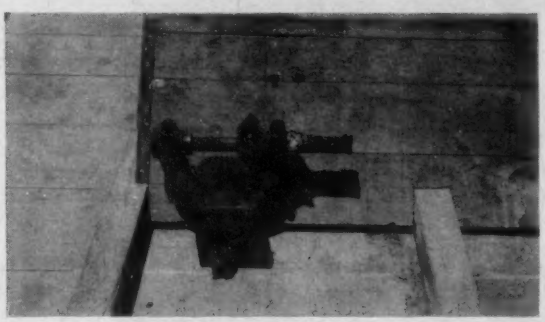

FIGURE 8.--One of two sets of bevel gears and frame used to transfer power through the deck, center bearing and turntable.

The center bearing, shown in Figure 9, consisted of 2 concentric steel cylinder bearings, 5/8 inch thick and 3 inches high, each welded to an 18 inch square plate, 5/8 inch thick. A clearance of approximately 0.010 inch was allowed between the cylinders. The plate containing the outside cylinder was fastened to the center of the table and the other half of the bearing to the deck. Eighteen truck caster rollers were arranged about the deck portion of the center bearing in a 10 foot diameter circle and raised to a height to conform to the plane on which it was desired to have the turntable rest. The rollers and center bearing were of sufficient height to assure the table clearing all obstructions, allowing about 2 inches clearance for sagging of the table. When assembling the center bearing, it should be well packed with grease and a pressure grease gunfitting installed.

While hauling, fairlead for the cork line was obtained by the vertical roller, known as the "dead head" or "extra man", shown at the upper left corner of the turntable in Figure 6. This device consisted of a solid wood roller mounted on a rod with a supporting frame and was used only while hauling the net. The top bar of the frame was held in position by two removable bolts. A fixed skeg, similar to that used for a rudder, supported the bottom of the roller shaft.

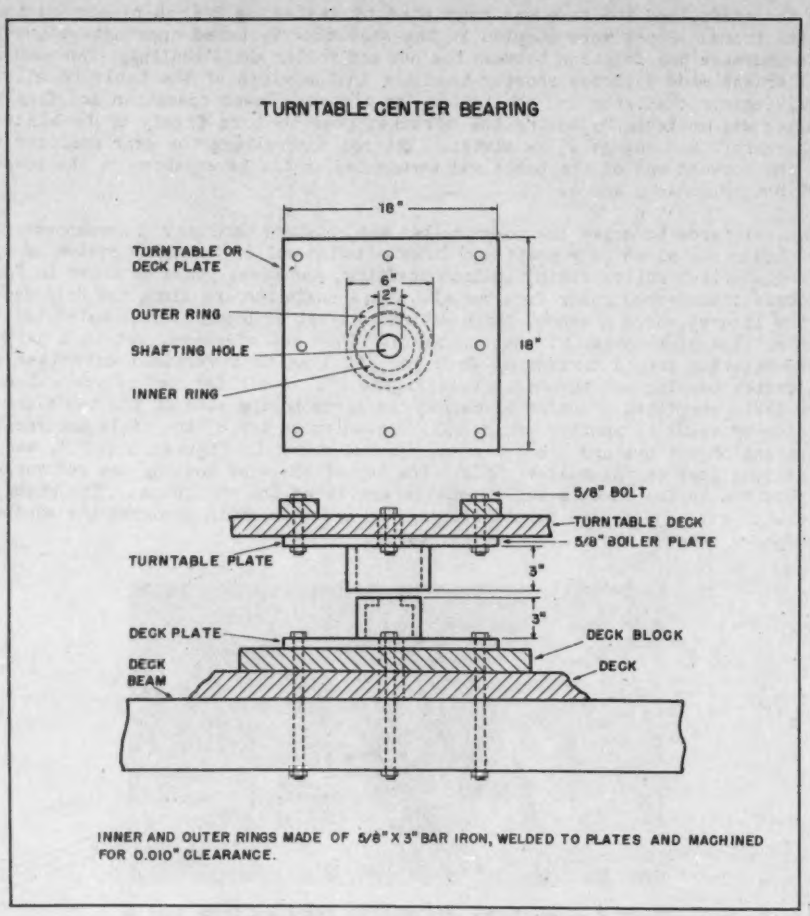

FIGURE 9.--Turntable center bearing.

Auxiliary Boats

Two flat bottom skiffs were used to assist in operating the seine. These were of substantial construction with heavy frames and the bottom planking running fore and aft. The larger or "seine skiff" was 18 feet long, 8 feet wide and the sides were 30 inches high. This skiff was used to start the net off the table, pull corks on the fish bag end and support the net while hauling and bailing.

The smaller skiff was used as a "striker boat" and to assist in supporting the cork line while bailing. It was 16 feet long, 5 feet wide, and 24 inches high on the sides.

Bail Net

The bail net (Figures 10 and 17) used for bringing the catch aboard, was operated by a single whip. The hoop was 4 feet in diameter and made of 1-inch pipe. The ends of the pipe were bent outward for bolting and seizing to a hickory handle 15 feet long. The hoop was supported by four lengths of 3/16-inch common chain as shown. The netting bag was 17

meshes deep, 120 meshes around and was hung by inserting a 15-thread rope through the top meshes and lashing this to the hoop at intervals of 4 meshes. After hanging, the hoop was covered with a section of rubber hose to protect the hangings and the fish bag. Twenty-four closing rings were uniformly spaced on a 12-thread rope passed through the bottom meshes; the rings were attached, with clove hitches, to bights of this rope at every fifth mesh.

FIGURE 10.--Bail net.

The bottom opening was 3 feet in diameter. A 3/16-inch twist link chain, 12 feet long, was passed through all of these rings, starting with the ring directly under the handle; one end of the chain was attached to this same ring, by means of a split link; a piece of 15-thread rope was secured to the other end of the chain in order to provide sufficient length for operation. The bail net was emptied simply by releasing the strain on the chain.

Purse Seine

A purse seine may be described briefly as a long rectangular piece of netting buoyed on the top by a cork line, weighted on the bottom by a lead line, and provided with a series of attached rings and a purse line for closing the bottom. On the net used on the Jeff Davis, both the cork and lead lines were approximately 200 fathoms long, while the breast or end lines were 9 fathoms long (except that when mackerel were sought the breast lines were lengthened to 15 fathoms).

In order to provide the "bagginess" required to entrap menhaden, the netting, which was coal-tar-treated before use, was of larger dimensions than those of the completed seine. The netting was 17,000 meshes long by 1,000 meshes deep, and was all of 1½-inch mesh, stretched measure. The main body of the net was of 20/12-cotton twine. The fish bag, located at the end frequently called the forward end, was 1500 by 1000 meshes of 9-thread netting, with the exception of 500 meshes square bail bunt of 18-thread material. As a selvage on the lighter portions of the net, there was a 5 mesh border, starting with 9 and progressing to 18-thread netting, with the outside ½ mesh doubled for extra strength. The principal features of the purse seine are shown in Figure 11.

The middle portion--170 fathoms--of the cork line was of 24-thread rope, while at each end 15 fathoms of 2 3/4-inch-circumference rope was employed. Corks were apportioned, 24 per fathom of line, with corks 7 inches in diameter supporting the fish bag and 4½-inch corks used on the remainder of the cork line. The entire bottom or lead line was of 18-thread rope, with one pound of seine leads added per fathom. The upper 8 fathoms of each breast or end line was a continuation of the 2 3/4-inch-circumference end cork line rope,

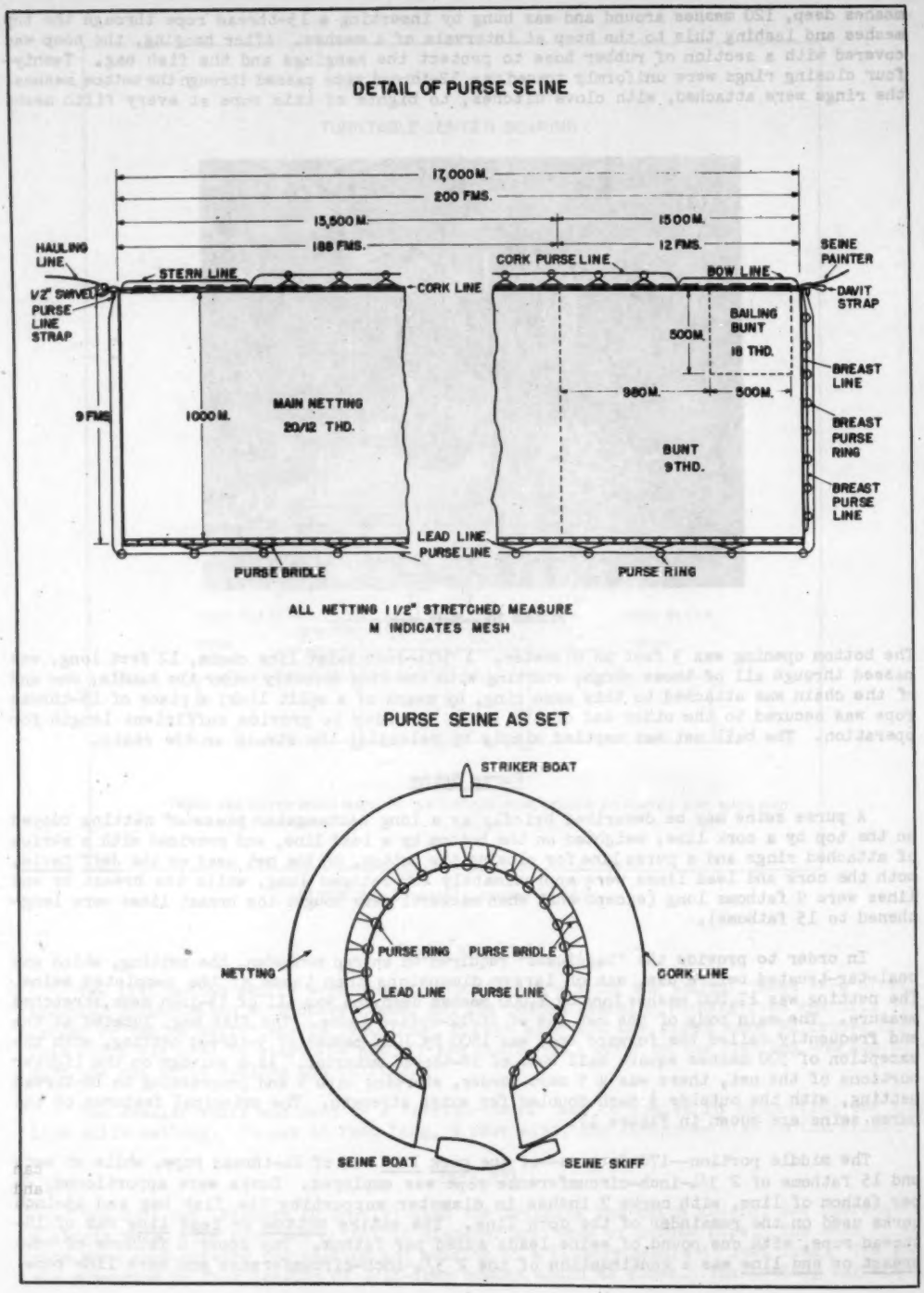

FIGURE 11.--Diagram of purse seine.

while the bottom one fathom was an extension of the 18-thread rope bottom line. All these lines were attached to the netting with 48-thread twine, used double on the cork line of the fish bag but single elsewhere. The junctions of cork and end lines were formed by seizing an 8 inch loop. These end loops served as points of attachment for the seine painter, hauling line, davit straps, breast purse line, bowline and stern line. Also, at the ends of the lead line were 4 inch loops for attaching the single end bridle.

Pursing bridles, rings, and lines were used along the entire lead line, the forward (fish bag end) half of the cork line, and the forward breast line. Bridles, each made of 2 fathoms of 12 thread rope, were attached along alternate two-fathom stretches of the lead line. A ½ by 5-inch brass ring was attached at the center of each bridle; thus, the rings were approximately 4 fathoms apart. The main- or bottom-purse line, which was passed through these rings, consisted of two equal sections of 5/8-inch-diameter rope. A long 3/8-inch common-chain end-link was spliced to each end of both sections. The two sections were joined by means of a ½-inch swing link, while during the setting operation, the remaining ends of the purse line were temporarily attached to the cork line with 15-thread rope straps.

Cork line purse-bridles, shown in Figure 12, were fashioned from sufficient 9-thread rope to reach over two bunches of corks (i.e. 12 corks or about 3 feet) and were attached at approximately 2-fathom intervals, beginning about 8 fathoms from the forward end and continuing to the middle of the seine. To the bridles were attached ½x3-inch galvanized iron rings. The "cork"-purse line was an 18-thread rope. Along the breast line, purse rings were attached directly to the line at 1-fathom intervals, and a breast-purse line of either 24 or 27-thread rope was used.

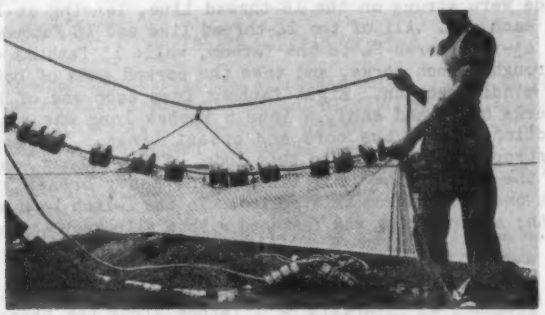

FIGURE 12.--Cork purse line and bridle.

Four other lines which were needed to operate the seine were permanently attached. The seine painter, 14 fathoms of 2 3/4-inch-circumference rope, was attached to the forward (fish bag) end of the cork line. The running or hauling line, approximately 100 fathoms of 2 3/4-inch circumference rope, was attached to the other end of the cork line through a 5/8-inch swivel. The bow line and the stern line were attached to the cork line at approximately 6 and 5 fathoms from the forward and after ends and were sufficiently long to reach the respective end loops.

Several lines and straps were necessary to assist in the operation of the seine. Most important was the purse lifting strap. For the comparatively light lift of a menhaden purse, a strap 2 fathoms long of 2 3/4-inch circumference rope with an eye splice at each end was adequate. The middle portion of the strap was placed outside of the bridles, as they hung from the davit, and the ends taken around and through the bridles and above the outside portion of the strap and hooked to the tackle. A more positive strap for heavy lifting can be made from a similar piece of rope by attaching common rope block hooks to the ends and seizing a thimble in the middle. If the purse line and netting were fouled, two frayed straps were used to lift the purse. These were made from a strand of 3½-inch circumference 3-strand rope 2½ fathoms long by fastening the ends with a fisherman's knot. The straps were wrapped directly around the purse line and both ends engaged in the tackle hook. This

permitted lifting the tangle aboard and clearing it on deck. Several shorter straps of this type were used for lifting various parts of the seine as required.

A ring holding strap, 20 feet long, was used to prevent the weight of fish or drift of the vessel from dragging the purse overboard. It was attached to the rail opposite the working side. After the purse was laid on deck, this strap was passed through half of the rings and the end made fast. Several rings were released at a time as needed to haul the net.

Stopping straps were necessary to support the fish bag after the fish had been dried for bailing. These were made of 12-thread rope and were of sufficient length to reach from ring bolts at the hatch to the rail and enable stopping the netting. Straps of similar rope, 6 feet long, were used to support and fasten the cork line in the skiffs.

Hanging the Seine

The seine used on the Jeff Davis was hung by the system commonly employed on the Pacific Coast. By this method, a definite length of stretched measure netting is hung to a predetermined length of cork and lead lines. Each of these series of measures, usually 10 fathoms if sufficient space is available, is known as a "course" or "stretch". The webbing is generally measured along the cork line side to determine the last mesh of the stretch and the corresponding lead line mesh is obtained by crossing the netting knots in the strip.

The ropes used for the lead, cork, and breast lines—202 fathoms 18-thread, 170 fathoms 24-thread, and two pieces of 23 fathoms 2 3/4-inch-circumference—were thoroughly wetted and all surplus turns removed to avoid kinking of the lines when the net is in use. Two hundred pounds of leads were strung on the 18-thread line, leaving at least one fathom of line without leads at each end. All of the 24-thread line and 15 fathoms of one heavy line were threaded through 4½-inch corks 24 to the fathom, while 15 fathoms of the other heavy line were threaded through 7-inch corks, and then the corked ends of both heavy lines were spliced to the longer middle section. Eight fathoms from each end of this composite line (that is, where the corks begin and end), a loop 8 inches long was seized with 48-thread twine to form the junction between the cork and breast lines. The seine painter, davit strap and purse line strap were attached to this loop. The 9-fathom long breast lines were completed by splicing the ends of the lead line to the heavy breast lines and seizing a 4-inch loop at a point one fathom from this splice. To the 4-inch loop was attached a single bridle, 5 feet in length; a purse ring was fastened with a slip knot to the other end of this bridle.

The fish bag end of the netting was evenly distributed and hung to the breast line. The breast rings were attached at intervals of 1 fathom along the breast line, the bottom one being located at the splice. The breast purse line was spliced to the lower ring, threaded through the remaining rings and attached to the cork line loop with a slip knot.

A "stretch" 10 fathoms long was laid out on the floor for measuring the cork and lead lines, and a stick 1 fathom long was prepared for measuring the netting. Ten fathoms of cork and lead line and 15 fathoms of stretched netting were measured and marked. After the netting had been measured along one edge, the knots were followed across the strip to determine the corresponding mesh on the opposite side. The lines were then suspended, fully stretched by hand, made fast and the measured portion of the netting evenly distributed between the marks on the lines. The fish bag section of the net was hung with double 48-thread twine along the cork line and single twine along the lead line. Hanging of netting was accomplished by means of a net needle and the common net hanging knot. Completed portions of the hanging are shown in Figures 12 and 13.

After the section was hung, the purse bridles were attached to the lead line. One end of the first full bridle was attached at a distance of 2 fathoms—the length of a full bridle—from the single or end bridle. The remaining end of the bridle was attached at a point further along the lead line so that the ring hung 6 inches below the stretched lead line. This spacing of bridles was followed throughout the seine—always allowing a 6-inch hang. The bow line was attached to the cork line at the point where the cork line would cross the stem when the net was being pursed, that is about 5 fathoms from the end. It was of sufficient length to reach the end of the seine. The cork purse line bridles were attached at 2-fathom intervals starting at a point 2 fathoms beyond the bow line.

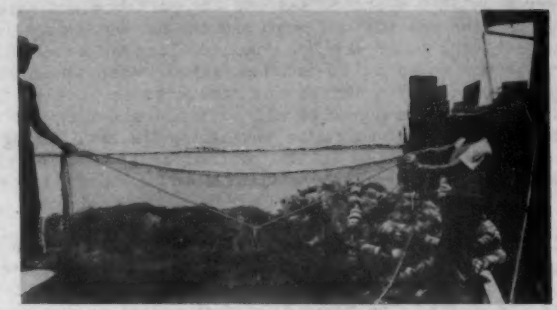

FIGURE 13.--Purse bridle.

After completing the first section, lines were threaded through the purse rings, in order to maintain their proper sequence; then the entire section was drawn to one end of the hanging course. The process of measuring and hanging the net was repeated until the full length of the net had been completed. The heavy after end section (2 3/4-inch-circumference) of the cork line and the after breast line were fitted and hung in the same manner as the fish bag end except that a 5/8-inch swivel was used to join the cork line loop and the running or hauling line. This swivel permitted the removal of turns which accumulated in the hauling line.

Operation of Seining Gear

The manner of setting and hauling the seine was quite similar to that used on the Pacific Coast. The seine was circled around the school of fish by the large vessel with the seine skiff acting as a drag initially to start the net off the turntable. Upon completing the circle, the skiff end was taken aboard the vessel and the bottom of the net closed or pursed. The net was then hauled onto the turntable and the fish concentrated in the bunt where they were bailed aboard with a dip net.

The following material is not intended to be of interest to the casual reader but rather to explain in considerable detail the method of operating the seine.

Previous to arriving on the fishing ground, both skiffs were launched and the "striker" boat was made fast to the stern of the seine skiff. The "strong back" (a 6x6 inch timber fastened by pins to the sides of the turntable and over the power roller to support the skiffs) was removed, and the seine skiff was made fast to the winch. The end of the net was hung over the stern to facilitate setting (Figure 14), the seine painter was attached to the middle of the seine skiff, and the power roller was placed in the idle position.

FIGURE 14.--Net arranged for setting.

The davit and "tom" weight were placed in position as shown in Figure 5. After locating fish, the vessel was maneuvered until the school was off the port bow and about 75 feet ahead of the vessel. The skiff painter was then released and the net set in a circle about the fish. As the seine was being set, the seine skiff was pulled along the outer side of the cork line in such a manner that its bow would be toward the seiner when the circle was completed. Two men were required to operate this skiff; one recovered and coiled the skiff and seine painters, while the other grasped and pulled all possible slack in the main purse line in order to minimize the possibility of this line entangling the net. During the setting stage, the striker-boat man cast off and rowed to the portion of the net across the circle from the skiff. After making fast, he immediately started to pull in all possible cork line to create a bag in that portion of the net.

After the vessel completed the circle, the seine painter was thrown aboard and passed through the forward pursing block for a lead to the winch. As soon as the fish bag end was brought to the davit, the davit strap was hooked to the davit, and the seine painter was removed from the block and winch. The purse line was engaged in the pursing block and the slack was rapidly hauled in by hand; then the purse line was engaged in one of the blocks on the "tom" weight, and power pursing with the winch was started. When the end strap had been hooked to the davit, the bow man—who had previously caught the seine painter and coiled it along side the house—unfastened the bow line from the net, pulled the cork line over to the bow and made the bow line fast. This prevented the corks being drawn under the vessel by the pursing strain. The painter was then made fast to the bow and the skiff men proceeded to purse the corks.

While these activities were taking place on the forward part of the vessel, the table was turned until the roller was over the port side, and the turntable bar was put in position (Figure 15). At the same time, the hauling line was taken through the after pursing block and preparations similar to those effected on the forward end were made for pursing. (If only part of net was set, the purse line was taken directly through the "tom" and pursing blocks and to the winch.) As the pursing strain increased, the lines lifted the "tom" weight off the rail. The "tom" line (Figure 5) was then gradually released from the winch until the weight rested on the bottom. During the pursing operation, the breast lines were held taut to avoid fouling the tom weight. Also the after end of the cork line was raised to the table by means of the stern line (similar to the bow line) and the corks were pulled in and piled in bights overhanging the stern.

FIGURE 15.--Hauling purse seine. Note the lead bar from the turntable to the rail and the cork line fair lead.

Shortly before the pursing operation was completed, the tom weight was raised and disengaged from the purse line and placed on deck. The forward cork line end strap was removed from the davit, and the breast purse line was raised until the entire breast line was clear of the water. The breast rings were then made fast to the pin rail.

As the last step in the actual pursing, the lead line purse-rings were hauled to the davit, the purse lines were secured to the horns of the winch, and the winch was stopped. A strap was then put around and through the bridles and hooked to the lifting tackle. The tackle was then drawn tight by hand, the purse lines were removed from the winch and power was applied to the tackle. The "purse", consisting of the rings, bridles and lead line, together with attached webbing, was raised until the bights of lead line were clear of the rail. As the "purse" hung from the boom, the bridles formed nearly a complete cone; a horizontal cross-section view of this cone would resemble a letter "C" with the opening against the rail. The bridles and bights of lead line in the forward half of the "purse" were already in correct order for the hauling operation and normally needed not be disturbed except to insure that the lead line was inside the rail. However, the after part had to be cleared, for otherwise during the subsequent hauling operation, the bridles and lead lines which must come first would be on the bottom. Clearing was accomplished by reaching into the opening and pulling the leads out and aft. The outside netting on the after part was pushed forward and held there. As the purse was lowered, the bottom bights of the lead line were pulled aft and the top bights pushed forward. The purse lifting-strap was then removed and the rings were straightened out by pulling on the line through them.

At this stage, if possible, the forward and aft purse lines were interchanged each haul, in order to maintain the lay of the line. The purse lines were overhauled until the connecting link was at the rings. The link was opened and a small line passed through the rings to maintain their sequence. That section which had been the forward purse line was passed through the after half of the rings and it was immediately attached to the after cork line end strap, which was on the turntable. Additional line was pulled through the rings so that the total line between rings and end strap was equal to the length of the breast line, approximately 9 fathoms. This portion of the line was coiled on the after end of the net, ready for the next setting operation, while the longer unthreaded part of the line was left coiled near the middle of the rings. One end of the former after purse line section was attached to the forward cork line end strap, and the other end was threaded through the forward half of the rings and connected to the former forward purse line. The bulk of this line remained coiled between the rings and the forward end strap. When only part of the seine was set, it was generally more convenient to back-haul the after purse line through the bunched rings on deck, until a point was reached where it had not been disturbed in the net pile on the turntable. On these occasions, the forward purse line was disconnected and turned end for end.

During the clearing operation on deck, the corks on the stern were dumped overboard and pushed to the port side of the vessel. The last portion of the cork line pulled on the table was made fast to the stern and the cork line fairlead or "dead head" was put in position. The after end of the net which was pulled onto the turntable just prior to completing the pursing operation was cleared for hauling. Also, during the same interval, the corks were made fast to the skiff and the cork purse line backhauled through the rings.

When all was in readiness, the power roller was started and the net hauled aboard as shown in Figure 15. The positions of the various crew members while hauling the seine are shown in Figure 15, and the distributions during the various operations are shown in Table 1.

Table 1 - Distribution of Crew During Phases of Operation

Type of Activity	S T A T I O N						
	Bow	Davit	Winch	Main Deck	Turntable	Skiff	Striker Boat
Setting	1	2	2	11	2	2	1
Start pursing	1	2	2	-	3	2	1
Pursing	-	2	2	-	4	2	1
Lifting purse	-	1	1	3	3	2	1
Clearing purse	-	-	-	4	4	2	1
Hauling	-	-	-	2	8	-	1
Bailing	-	-	1	8	-	1	1

Two men were required to pull and lay the cork line, which was arranged in large crescent-shaped bights on and overhanging the corner and sides of the table. One man laid the lead and purse line in equal lengths in an elongated coil along the opposite edge of the table. A second man on deck pulled the purse line through the rings as required. His other duties were to clear the purse on the rail and operate the power roller control lever. An additional man assisted if considerable clearing was necessary on deck. The remainder of the crew, with the exception of one man in the "striker" boat, pulled the netting and piled it in an orderly manner. The first two-thirds of the seine to be hauled was piled on the half of the table away from the power roller. When the portion of the net attached to the striker boat was reached, the cork line was released as needed to permit hauling. After the corks had been released from the striker boat, it was made fast to the seine skiff until needed for bailing. The cork purse line on the seine skiff side of the striker boat had previously been back hauled and was in the correct sequence for hauling. The cork line and cork-purse line, attached to the skiff, were paid out evenly to assist in hauling. Improved lead in hauling this portion of the net was effected by moving the skiff painter from the bow to near the midpoint of the vessel, thus placing the skiff opposite the power roller. Shortly before the fish bag was reached, the bow of the seine skiff was pulled to the vessel and the fish bag cork line made fast to the side of the skiff and the striker boat as shown in Figure 16.

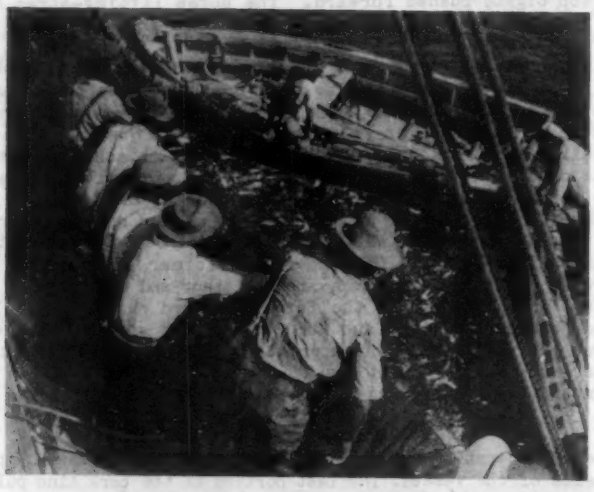

FIGURE 16.--Drying the catch.

When the cork line had been secured to the boats, all possible webbing was drawn on the table and the net was stopped off by a strap running to the opposite rail and the fish "dried-up" by pulling on the webbing as shown in Figure 16. The netting at the rail was stopped off by straps from the hatch. Bailing was accomplished, as shown in Figure 17, by dipping the bail net into and pulling it through the fish and then hoisting the net aboard with the single whip. The fish were dropped in the hold by releasing the purse chain at the bottom of the net. After the bailing was completed, all straps were released, the webbing on deck dumped overboard, the cork line released and the net hauled aboard. The table was turned, placing the roller over the stern, and the gear made ready for another set.

Preservation of Gear

Menhaden nets deteriorate quite rapidly and frequently two nets are required for a season's fishing. These nets capture tremendous quantities of fish and are exposed to severe slime conditions from contact with the bottom as well as with the fish. In addition, the high daytime temperatures tend to accelerate deterioration. Menhaden fishermen evidenced considerable concern as to the feasibility of preserving a net on the turntable.

FIGURE 17.--Bailing the catch.

In the present fishery, after each day's fishing, it is customary to overhaul the net in the purse boats, mend the holes and salt the net while repiling it. The net may also be "brined" by pouring a strong salt solution over it. The solution seeps through the net, is collected in the bilges and is recirculated several times. On days when the net is not used, it is merely subjected to the brine treatment.

As a preservative measure, the seine on the Jeff Davis was given a thorough washing in addition to a salt treatment. While the net was being overhauled from the turntable to the main deck (Figure 18), it was washed with a strong stream of ocean water delivered by a 3-inch centrifugal pump. The net was then repiled on the table and 500 pounds of salt distributed throughout the webbing. This combination of a wet net and salt resulted in a strong brine. If the seine was not used for several days, 300 pounds of salt were dumped on top of the pile and about 100 gallons of water poured over it. As the bottom of the table was tight, the resulting brine collected there, and was directed by a series of drain holes through the reinforcing timbers to the forward corners of the turntable, where holes permitted drainage to the deck and recovery of the brine. The brine was recirculated as many times as desired.

When not in use the seine was covered with a canvas tarpaulin in order to protect it from direct sunlight and foreign matter. Whenever practical the net was placed on a reel to allow it to become thoroughly aired.

California sardine nets are generally washed and the fish bag half of the net salted as it is hauled. At least once and preferably twice a month, the net is immersed in a bluestone (copper sulphate) solution. This solution has a pronounced cleaning action and appears to be a superior method of preservation, for the nets usually last two or more seasons.

EXPERIMENTAL OPERATIONS

Trial of Equipment and Methods

Although the principal objective of this investigation was the development and trial of improved fishing equipment and methods, yet it would be impractical to present a detailed description of all the experimental procedures employed, the results obtained and the difficulties encountered. A brief, "running" account of the general activities are recorded

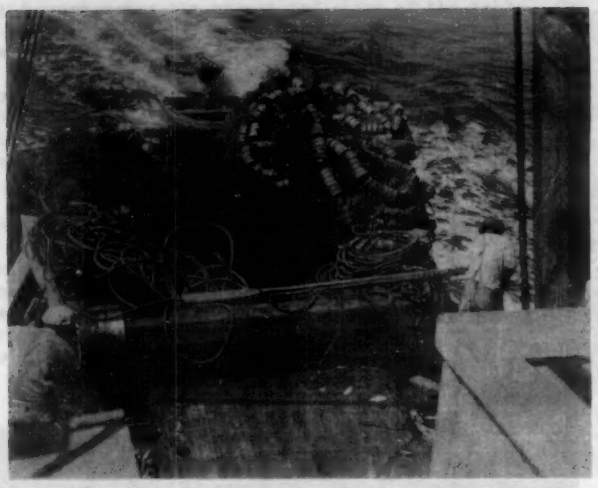

FIGURE 18.--Turntable turned for overhauling and washing seine.

in the last section (V) LOG OF OPERATIONS. In general, the vessel and gear were engaged in menhaden fisheries whenever the fish were present, a reasonable market existed, and the weather permitted. When it was not possible to operate in the menhaden fishery, the possible utility of the vessel in other fisheries was investigated. The limited experimental purse seining for, and the observation of schools of, Spanish mackerel were encouraging, while attempts at using the vessel in the coastal line fisheries were moderately successful. (Following the completion of this investigation minor changes were made in the vessel and then it successfully operated as a shrimp trawler.)

During the course of the investigation, experience with the equipment and methods indicated the necessity or desirability for various changes. Whenever it was feasible, the alterations were made immediately, in order that the new modifications could be tested in actual operation. However, because of the shortage of time and limited funds, it was not always possible to make the desired changes. In Section IV, CONCLUSIONS AND RECOMMENDATIONS, both the tested and the proposed improvements are discussed and the observations made during the investigation are summarized.

As had been expected, the menhaden exhibited a tendency to swim into the net and, because of their numbers, to submerge the cork line sufficiently to permit the escape of a large share of a catch. The effect of this tendency was decreased by the use of more and larger corks and by increasing the rate of pursing of the cork line. Just prior to the conclusion of the investigation, the cork purse line, together with its accessories, was extended to permit pursing of the entire cork line. Unfortunately it was not possible to give this modification any practical tests.

Another serious problem was the frequent tearing of the net as the result of entanglement with the rudder. Because of the construction of the after end of the vessels employed and the different characteristics of the fish, a Pacific sardiner seldom experiences this type difficulty. The construction of an efficient and permanent "guard" over the rudder was attended with excessive difficulty. The vibration stresses broke the guards leaving ragged edges which tore the net. However, a guard which was fully satisfactory was finally installed.

Menhaden Fishing Notes

Although in previous years shrimp trawlers have reported sighting large schools of menhaden showing "good" color during their fall and winter operations in the New Smyrna-Cape Canaveral area, in 1944 no such large schools were observed in that area until the latter

part of April. During two days in January,spent outside of New Smyrna, there was no evidence of any heavy schools, but isolated menhaden were seen flipping over a very large area. On January 20,a set made on a few isolated flips yielded 25 M* of menhaden and it was estimated that at least an equal quantity escaped over the cork line.(Part of the difficulty in retaining this catch resulted from the "stickiness" of the net, which was being used for the first time.) The weather in March and early April was generally quite unfavorable for extensive menhaden operations but after periods of several relatively calm days numerous "mud-riles" exhibiting flipping menhaden were observed one to three miles off shore. Several of these were believed to contain in excess of 200 M. Excellent signs of menhaden were observed through the latter part of April and the first half of May. The waters close to shore for a distance of 15 miles on either side of New Smyrna were literally full of menhaden. Greater signs of abundance were observed here during this period than were seen outside of Amelia Island in the latter part of May, when both of the Fernandina reduction plants were operating to capacity. South of St. Augustine there were found considerable quantities of menhaden which would supplement fish caught in the New Smyrna area. In order to establish a menhaden fishery at New Smyrna, it is most essential that the bar be improved to provide a permanent year around entrance for large fishing vessels.

The area off northern Georgia and southern South Carolina exhibited pronounced possibilities for the introduction of a menhaden plant. There, during the latter part of June, tremendous quantities of menhaden were located between Sapelo and St. Helena Sounds. Shrimp trawlers stated that this abundance had been noted for several weeks and extended well above Edisto Island. The largest portion of these fish were concentrated on and near the shoals but schools of considerable size were located as far as ten miles outside the Savannah Lightship. The schools were far more numerous and larger than those out of Fernandina. At least 50 of these schools were estimated to contain in excess of 500 M. Plentiful signs of small schools were also seen in inside waters between Port Royal and Sapelo Sound.

It is generally believed among commercial fishermen that menhaden move north in the spring and summer and have a southerly migration in the fall. A study of menhaden migration was not the purpose of this work,but several experiences worthy of mention indicate a degree at least of offshore-inshore migration. In January, no sign of menhaden was observed along the beach from Brunswick Entrance to New Smyrna but good signs of scattered menhaden were observed 5 to 14 miles offshore from New Smyrna and Daytona Beach. Running at night at distances of 5 to 8 miles offshore between St. Augustine and Fernandina disclosed numerous small bodies of phosphorescence believed to be caused by small menhaden. The menhaden at New Smyrna were almost invariably of a uniform size--between seven and seven and one half inches in length. Uniform schools of this size of fish do not generally appear out of Fernandina until the latter part of June or July and mixed schools are common even then. This would indicate that the schools were not moving north as a unit or that they were moving and mixing with small fish. Reports from handline fishermen indicate that menhaden are present off New Smyrna all summer.

Supplemental Fishery Possibilities

Experimental and exploratory operations to determine the possible utility of the modified shrimper-seiner, Jeff Davis, in a variety of fisheries along the South Atlantic Coast, demonstrated that profitable fishing operations could be carried on throughout almost the entire year. Although the vessel was constructed specifically for shrimp and menhaden fishing, it could effectively engage in a number of other fisheries.

Unfortunately, in 1944, the Spanish mackerel (Scomberomorus maculatus) did not migrate northward along the East Florida Coast in their usual abundance. After the conclusion of the Florida Keys season this species is normally taken in large quantities off Miami, West Palm Beach, Fort Pierce and Cape Canaveral, in the order named, during March, April,and early May. Again in September and October, large schools appear and form the basis for a substantial fishery off Cape Canaveral. Shrimp trawlers report that Spanish mackerel also appear in large schools off South Carolina during these same fall months. During January and March of 1944 no mackerel were observed in the exploratory fishing operations from Melbourne, Florida, to Sapelo Sound, Georgia. On April 3, two "jumping" schools were sighted, but they were too wild to encircle. Otherwise, during April, May,and early June signs of

* Menhaden are normally sold by the measure, M, which originally was a volume intended to hold 1,000 average fish. This volume is generally 22,000 cubic inches and will hold approximately 640 to 670 pounds of menhaden.

Spanish mackerel were frequent, but they were usually scattered. Small quantities often were taken with schools of menhaden. During the latter part of June they were seen more frequently, and there were encouraging signs of a tendency to form small schools. Despite the scarcity of the species, sufficient observations were made to convince the investigators that Spanish mackerel could be profitably fished with the Jeff Davis during some seasons of the year, and that the purse seine used during the investigation would probably be suitable for capturing the fish if the breastlines of the seine were lengthened to approximately 15 fathoms for deep water fishing.

No great abundance of bluefish was noted at any time during the investigation. They occasionally appeared in appreciable numbers in hauls of menhaden. Usually they were in company with Spanish mackerel. Bluefish alone might not support a profitable activity, but the catch of this species would add measurably to the income of a vessel engaged in fishing Spanish mackerel.

Red groupers could possibly be taken with the Jeff Davis purse seine, but those schools observed exhibited a tendency to move quite rapidly. In the one set intended to encircle a school of this species, a large catch of thread herring was unexpectedly taken instead.

Thread herring, also known as kyaks and hairy backs, were found to be quite plentiful near shore north of Cape Canaveral on two trips made in the latter part of March and mid-April. These schools were quite extensive in size and were estimated, by experienced fishermen, to contain well over 100 M. In June, numerous schools of this variety were located between 10 and 15 miles offshore along Amelia and Cumberland Islands. In the last part of June, schools of thread herring were observed ten miles further offshore than the Savannah Lightship.

The results of the line fishing trials off Georgia and northern Florida demonstrated that the operation of the Jeff Davis in such a fishery would be preferable to permitting the vessel to remain unused, tied to a dock. The vessel could earn a small income in the line-fisheries and a skeleton crew of two or three men could be profitably employed. A larger crew would be unnecessary and uneconomical.

Weather Encountered

Although the weather during the first months of 1944 was reportedly worse than normal, only a small part of each month was totally unsuitable for any type of fishing operation. On those days when cloudy skies, a high wind, or excessive swells made purse seining inadvisable, it was frequently possible to handline for fish.

A clear sky, accompanied by a mild offshore breeze and little or no sea, constitutes ideal weather for menhaden operations off the East Coast of Florida. Menhaden are occasionally taken during periods of light easterly weather, but if the wind reaches moderate force, the schools tend to split and disappear.

Handlines may be operated under quite adverse weather conditions. The limiting factors are the current, intensity of the wind and height of the sea. Severe conditions of this nature result in rapid drifting of the vessel over the small spots of fish, thus preventing holding the bottom with handlines and rendering it inadvisable to anchor on the uneven ground which reef fish inhabit. Handlining operations were limited if the wind had been blowing more than 20 to 25 miles per hour for a prolonged period.

As weather conditions at sea frequently differ markedly from shore conditions, it is not feasible to estimate the fishing possibilities on the basis of shore station weather observations. The most accurate data on this subject can be obtained only from the logs of fishing vessels. A summary of the weather encountered by the Jeff Davis fishery investigation is given in Table 2. The table shows the types of fishing activity possible for each day—in the area where the Jeff Davis was then located. As the vessel was not active during February, no data is given for that month. Although the search for schools of fish was continued throughout June, no data are included, for the fishing industry knows well that nearly every day of the month is suitable for menhaden seining. The weather encountered is classified under three categories:

Table 2 - Type of Fishing Activity the Weather Permitted

Date	January			March			April			May		
	Purse seine	Hand line	Unfit	Purse seine	Hand line	Unfit	Purse seine	Hand line	Unfit	Purse seine	Hand line	Unfit
1	*	*	*	*	*	*	-	-	NS	*	*	*
2	*	*	*	*	*	*	-	NS	-	SA	SA	-
3	*	*	*	*	*	*	NS	NS	-	F	F	-
4	*	*	*	*	*	*	-	-	NS	SA	SA	-
5	*	*	*	*	*	*	-	-	NS	NS	NS	-
6	*	*	*	*	*	*	-	NS	-	*	*	*
7	*	*	*	*	*	*	NS	NS	-	*	*	*
8	*	*	*	*	*	*	NS	NS	-	SA	SA	-
9	-	F	-	-	F	-	*	*	*	SA	SA	-
10	-	F	-	F	F	-	*	*	*	-	NS	-
11	-	-	F	-	-	F	NS	NS	-	-	-	NS
12	-	F	-	-	-	F	CC	CC	-	-	-	NS
13	-	-	F	-	SA	-	-	CC	-	*	*	*
14	-	-	F	-	NS	-	-	CC	-	*	*	*
15	-	F	-	NS	NS	-	-	CC	-	F	F	-
16	F	F	-	-	NS	-	*	*	*	F	F	-
17	-	-	F	-	NS	-	*	*	*	F	F	-
18	-	-	F	NS	NS	-	NS	NS	-	F	F	-
19	-	F	-	NS	NS	-	NS	NS	-	F	F	-
20	NS	NS	-	-	-	SA	NS	NS	-	F	F	-
21	NS	NS	-	-	-	SA	NS	NS	-	*	*	*
22	-	F	-	-	-	NS	F	F	-	F	F	-
23	*	*	*	-	-	NS	*	*	*	*	*	*
24	F	F	-	NS	NS	-	-	-	F	*	*	*
25	F	F	-	NS	NS	-	NS	NS	-	F	F	-
26	-	F	-	NS	NS	-	NS	NS	-	F	F	-
27	F	F	-	CC	CC	-	NS	NS	-	F	F	-
28	F	F	-	-	CC	-	-	-	F	F	F	-
29	F	F	-	-	NS	-	-	-	F	F	F	-
30	*	*	*	-	NS	-	-	-	F	F	F	-
31	*	*	*	-	-	NS				F	F	-
Total	8	15	5	8	16	7	13	18	7	20	21	2

Note: Letter indicates base or land mark near area of operation.

CC - Cape Canaveral
F - Fernandina
(* - no observation)
NS - New Smyrna
SA - St. Augustine

Days noted unfit are unsuitable for either handlining or purse seining.

1. Purse seine - suitable during the whole or part of the day for menhaden purse seining.

2. Hand line - suitable for handlining but too severe for menhaden operations.

3. Unfit - unfit for either type of activity during the entire daylight period.

This division is arbitrary and separated according to conditions on the fishing ground which are frequently quite different from those on shore. The days classed as suitable for purse seine fishing merely indicate the possibility of operating the gear and should not be interpreted to mean that menhaden were observed.

Fishing captains who operated for menhaden out of Fernandina stated that January weather during 1943 was exceptionally good, but that of January 1944 was somewhat worse than average. Handline fishermen at New Smyrna indicated that the March weather of 1944 was considerably worse than average as they were normally able to make several trips to Cape Canaveral. In 1944, not more than one trip was possible. They believed the April weather was slightly worse than average, but the weather during the first part of May was normal. A comparison of the weather encountered by other boats disclosed that there were more days favorable to fishing off New Smyrna than out of Fernandina.

Time Required to Train Crew

All of the original crew of the Jeff Davis were experienced in operating the conventional type of menhaden seine from two purse boats. Unfortunately, the crew did not assist in hanging the gear and thus did not have an initial prolonged period to become familiar with the hanging and purpose of the various labor-saving lines which were not used on their accustomed gear. Fortunately, however, they were all experienced in the use of a "tom" pursing weight and needed no instruction in this phase of the operation.

The first set required nearly three hours' time. After five hauls had been made, the men were quite familiar with the method of gear operation and the various additional lines. At this stage, the need for detailed and minute supervision of each individual's actions was definitely lessened. However, ten hauls were made before there was evidence of the teamwork necessary for quick and efficient operation of the gear. Only general supervision was necessary at this stage and there was a noticeable tendency toward individual action to meet unusual conditions as they were encountered. After twenty hauls had been made, the crew had a thorough understanding of the gear, exhibited a fair degree of teamwork, and were able to operate the gear with a minimum of supervision.

During the progress of the work, several changes occurred in the crew. The new crew members were also experienced menhaden seiners; after three sets, aided by extensive advice from the trained men, they were able to perform their duties in a capable manner.

The length of time required to operate the gear and bail the catch, as shown in Table 3 in the "Log of Operations", is extremely variant. Much of this difference can be attributed to the tearing of the net and time lost in clearing the webbing from the skeg. Also, there was a psychological factor which tended to slow operations when the net was torn and a large portion of the catch lost. Another factor which affected the hauling time was that the Jeff Davis was the only vessel operating the gear in this manner and no time standards of operation had been established through years of practice. Consequently, there was a tendency on occasion for the crew to expend energy at a much lower rate than when operating the existing type of gear. On the basis of observations made when conditions were favorable, it is believed that a set yielding 100 M can be made readily in 1½ hours' time.

CONCLUSIONS AND RECOMMENDATIONS

Advantages and Disadvantages of Equipment

The experimental fishing studies revealed that a vessel of the Jeff Davis type, under certain circumstances, at least, could be employed profitably in fishing for menhaden. Although in some respects purse seining according to the Pacific method is inferior to the

present standard procedure, the former has sufficient advantages to warrant its adoption in some areas.

The most evident advantage of the Pacific Coast method is the low initial investment for the vessel. The Jeff Davis, complete with all equipment including the winch and turntable, was built at a cost of approximately $20,000. A vessel, 75 feet long, employing the light construction common to Florida and Gulf vessels, as suggested in a later section, would probably cost slightly in excess of $30,000. In contrast the usual menhaden vessel, shown in Figure 19, requires at least a $100,000 investment. In fact, the expense of a single complete overhaul of the hull of the larger vessel could exceed the original purchase price of the proposed 75 foot purse seiner-trawler.

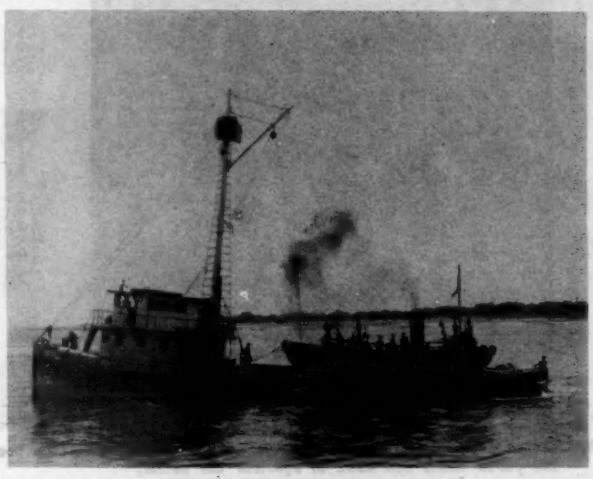

FIGURE 19.--Menhaden purse seiner.

On an annual basis the cost of seining gear operated from the main vessel should be only slightly greater than the cost of gear operated from two purse boats. The netting required for each type gear is essentially equal, and replacements will be required at the same intervals. The Pacific type seine, however, would employ a larger number of corks, 4,500 as compared to 2,000 for the usual menhaden seine. As good corks--which cost about 12¢ each--should last five years or longer, the difference in costs per year should not exceed $60. The extra quantity of rope, 100 pounds per season, for cork purse lines, etc., should not cost over $35.

The accessory equipment (Figures 20 and 21) necessary to operate according to the present method is more expensive than that required to operate off the main vessel. The former employs two power operated purse boats and a striker boat, with a total value of over $2000; the latter needs only two unpowered skiffs costing less than $400. Furthermore, the engines in the purse boats require regular maintenance and occasionally cause the loss of fishing time because of mechanical difficulty. Although the cost of construction and installation of the turntable, $500, was included in the amount quoted for the completed vessel, probably it should be classified as auxiliary equipment. A turntable of substantial construction, properly installed and lubricated, can be expected to give ten years of trouble-free operation. The only significant expenses would be those of occasional replacements of the roller chains and possibly the bevel gears.

Under normal conditions, with an 11-man crew well versed in the handling of the gear, it is estimated that operating a seine from the main vessel and bailing a catch of 100 M would require not over 1½ hours. A crew of 22 operating the usual equipment and gear under similar conditions would require approximately one hour. Thus, the man-hours required per set are considerably less for the Pacific type seining method. This time could be further

reduced by the use of a cable winch for bailing (Figure 22); however,the deck type operation can not take full advantage of the cable winch, for the bailing must be stopped periodically to "dry"—or concentrate—the catch. When two purse boats and a large crew are used, the catch is dried up by the men in the boats, and the bailing operations are not interrupted.

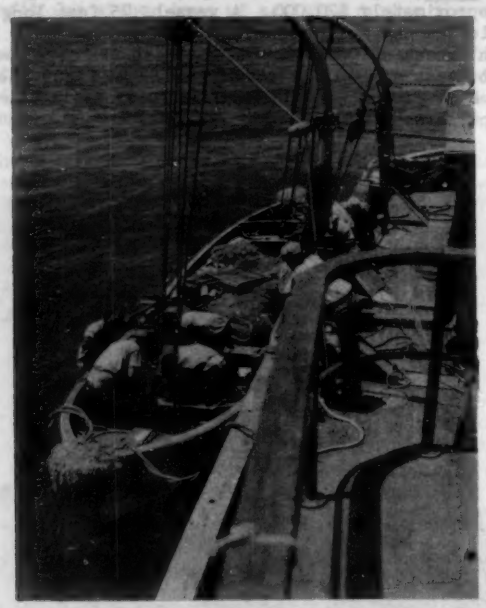

FIGURE 20.--Menhaden purse boat. Note the boat davits for raising the boats. Two purse boats are used to operate the seine.

For most rapid handling of the net, the stern should be wider than on the Jeff Davis. A wide stern would permit a longer power roller and consequently increase the purchase on the net and improve the angle from which it is hauled. Also, far more working space and freedom of movement would be permitted in hauling the fish bag half of the net.

FIGURE 21.--Menhaden purse boat suspended from the davits.

There was no indication that one type of outfit could be operated in more severe weather than the other. In any event, this factor is of no importance as menhaden ordinarily cease to show in Florida waters when the state of the weather would prohibit operations by either method. The Jeff Davis naturally offered greater wind resistance then the purse boats and tended to drift faster and rise more sharply on a sea, thus increasing the pursing strain. However, it presented more comfortable working conditions in a seaway and there was no danger of swamping due to the weight of the catch and the sea.

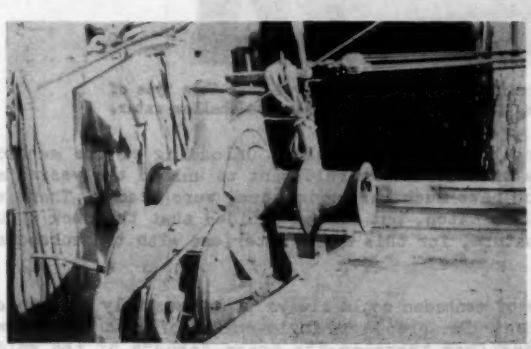

FIGURE 22.--Combination pursing and wire cable bailing winch.

The two purse boat method presents definite advantages when working just outside the breakers in a light on-shore wind, as the large vessel can serve as an emergency tow boat to prevent the equipment from drifting ashore. There is a tendency for menhaden when surrounded to carry the net and boats a short distance offshore. However, this tendency was insufficient to remove the Jeff Davis to a position of safety if the force of the wind increased. Consequently in periods of light on-shore winds, it was advisable to select schools at a reasonable distance from the beach and depend on anchors to prevent drifting if the wind increased.

During the operation with the Jeff Davis some difficulty was experienced with the purse line fouling the net. This occurred more frequently than was normally experienced with the two purse boat system of operation. The major source of this fouling appeared to be caused by the V-type purse bridles shown in Figure 13. A set of bridles, shown in Figure 23, similar to those normally used on menhaden seiners had been prepared for use on the Jeff Davis when operations had to be abandoned. Sets made in depths of three fathoms and over seldom were troubled with these fouling difficulties. When tangles did occur, they could be readily freed by pursing as much as possible and then lifting the entire bottom of the net aboard and clearing it. If purse line fouls occur in the two purse boat system, it is necessary to clear the line in the water when it is under strain or call the main vessel to assist.

No difficulty was experienced in surrounding menhaden with the type of seine used on the Jeff Davis. Certain precautions, however, were found advisable. While the school was being inspected, the vessel remained or circled at a distance of 200 to 300 yards from the spot. After the determination to set had been made, the headway of the vessel was increased to the desired setting speed and this was maintained until the circle was nearly complete.

It was found that suddenly starting the propeller in motion or increasing the engine speed would disturb the fish. A tendency for menhaden to move away from the vessel was noted on days when they were restless. As setting the seine continued, the fish appeared to make a smaller circle than the boat and to return to their original location when the circle was completed.

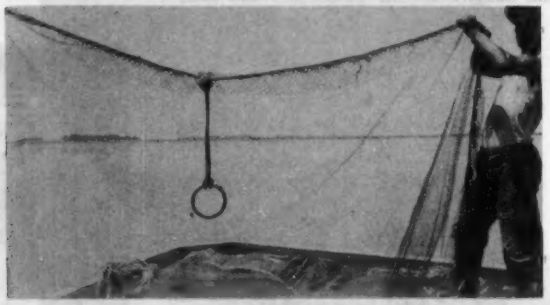

FIGURE 23.--Menhaden type purse bridle. Note: It is believed that this type of bridle will cause less fouling of the purse line on shallow water.

The hatch on the Jeff Davis was too small for convenient unloading of the menhaden by the existing methods; therefore, the shovelers were reluctant to unload the vessel and refused if other menhaden seiners, which have much larger hatches, were ready. There was sufficient deck room to permit an adequate hatch, but it was decided that the deck should not be cut up for work of a temporary nature, for this might interfere with the subsequent shrimping operations of the vessel.

During fishing operations, schools of menhaden could always be successfully surrounded. The only problem was in saving these fish. The greatest single source of loss of fish was caused by huge holes in the net resulting from tears on the sharp corners of the welded skeg and on the broken portion of the two types of guards which proved to be of inadequate construction. Occasionally moderate numbers of fish escaped over that portion of the cork line not equipped with a cork purse line; these losses were infrequent after introducing the use of a striker boat. There was never any indication of a tendency for the cork line to be drawn under on that half of the net equipped with a cork purse line. Some difficulties were encountered by fouling of the main purse line, but they were greatly reduced when a man in the seine skiff maintained tension on the purse line while the net was being set. It was believed that fouling could be reduced to no more than that experienced in the two purse boat method, if the usual menhaden seine bridle were used in place of the West Coast type. On the Jeff Davis, the clearing of fouls was a minor problem, for they could be lifted aboard and readily cleared.

The experienced menhaden fishermen aboard believed that the new skeg and rudder guard and the changes which were being effected on the seine would solve all difficulties which had been experienced in saving the menhaden encircled by the net. It is regretted that several weeks of additional fishing were not possible to provide data to verify this belief.

Vessel Requirements

Although the Jeff Davis was found to be suitable for the operation of a Pacific type seine in the menhaden fishery, it is evident that improvements in design and size are quite possible. The Jeff Davis has sufficient carrying capacity for profitable operations in the fisheries for shrimp and other relatively high priced food fish, but in the menhaden fishery a larger vessel of greater capacity would be more profitable for the owner.

The design of the Jeff Davis could be improved by carrying the 18-foot beam well toward the stern and increasing the length of the fish hold. By increasing the transom from 10.5 feet to 16 or 17 feet, the buoyancy of the 10 foot long lazaret would be increased by approximately 60 per cent. This would have increased the fullness of the after portion of the

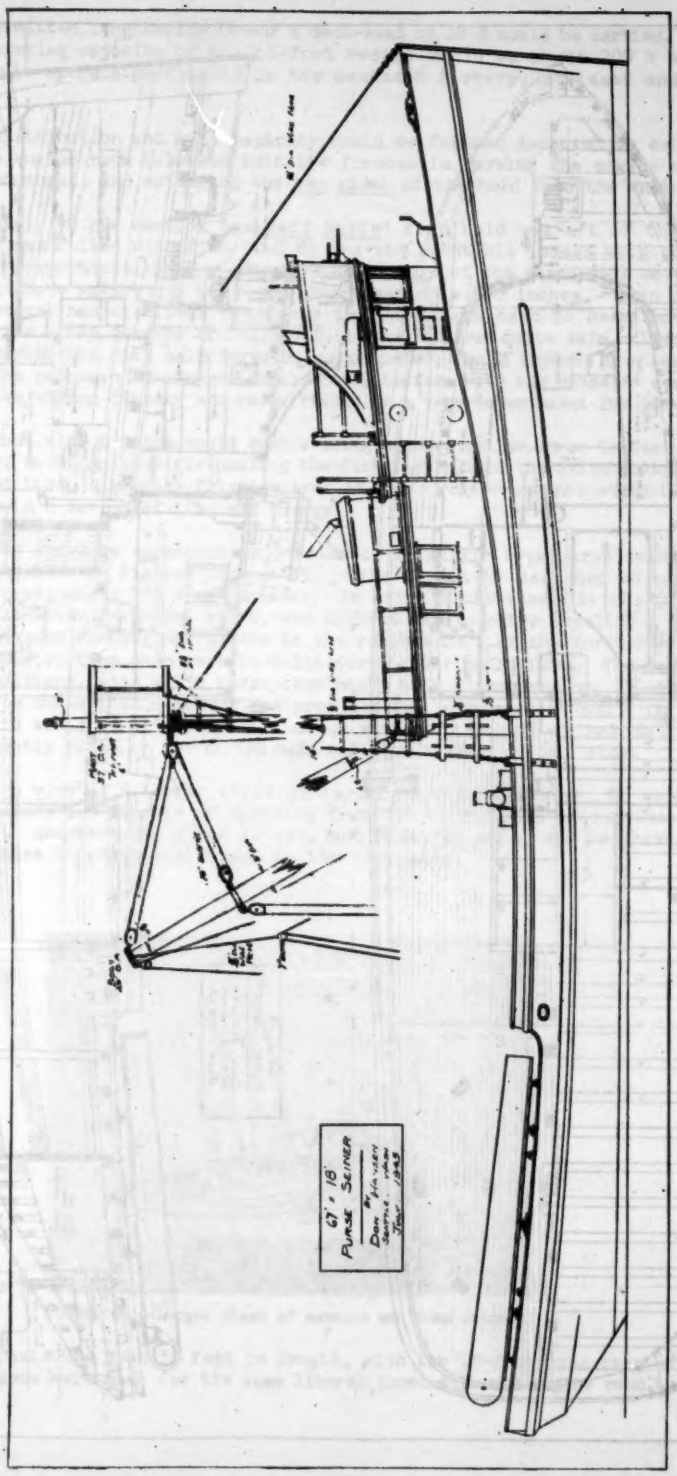

FIGURE 24.--Profile view of 67-foot long Pacific type seiner.

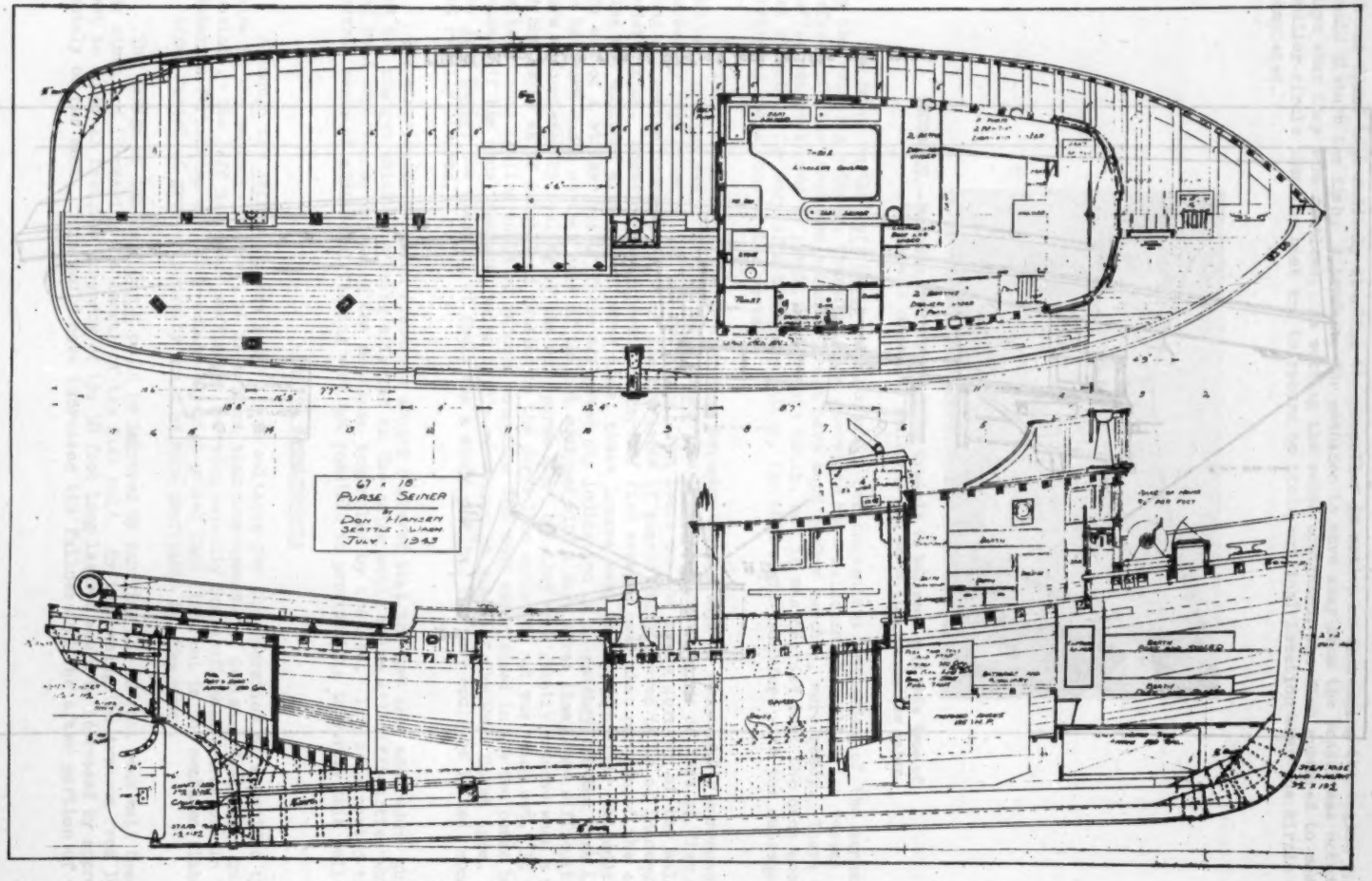

FIGURE 25.--Construction details of a 67-foot Pacific type seine

fish hold, and permitted lengthening it—or a deck-load of 40 M could be carried. In either case the total carrying capacity of the 65-foot vessel would be about 200 M and thus it would be possible to operate profitably in the menhaden fishery, at least under wartime conditions.

The weight distribution and hold capacity could be further improved by extending the midportion of the engine room bulkhead into the forecastle, moving the engine and forward fish hold bulkhead ahead, and extending the two sides of the hold into the engine room.

As approximately 90 per cent of the Jeff Davis' fish hold was aft of the midpoint, whenever the hold was filled with fish (140 M) and the turntable loaded with the wet net, the stern rode disproportionally low. When the lower edge of the guard rail on the transom was only one inch above water, the stem was depressed only two inches. Even under these conditions, the vessel had excellent reactions in a moderate head to beam sea, but when the swell was on the after quarter or following, it was wet but quite safe. Increasing the beam aft and extending the fish hold forward, as proposed, would improve the seaworthiness of the vessel. The recommended changes should not interfere with the vessel's seaworthiness when engaged in the shrimp fishery and would result in a vast improvement for purse seining.

A 16 or 17 foot wide transom would enable using a power roller 15 or 16 feet in length; thus, the amount of working space for hauling the fish bag half of the seine would be greatly increased. In addition, a greater friction area of power roller and net would be provided; this would result in a saving of time and energy.

A profile view and some construction details of a Pacific type purse seiner, 67 feet in length, are presented in Figures 24 and 25. This vessel is designed to pack 90 tons of sardines or approximately 270 M of menhaden. In addition, the vessel is of a type suitable for engaging in fisheries for tuna, shark, and halibut and in otter trawling. This vessel is capable of sustained fishing operations in the rough waters of the North Pacific and is of much heavier construction than vessels built for the shrimp fishery. The cost complete under wartime conditions, with a 150 horsepower heavy duty diesel engine, is approximately $45,000. It may be noted that quarters are provided for 4 below deck and 6 in the cabin. A small house, which would be suitable for housing a white captain and engineer in the menhaden fishery, is frequently built on top of the main cabin of vessels of this size.

Figure 26 is a view of a larger class of sardine and tuna seiner, 80 to 95 feet in length. These vessels are capable of carrying from 150 to 250 tons of sardines or 450 to 750 M of menhaden. Quarters for 10 to 12 men, and possibly more, can be provided in the main cabin, and there is additional space in the top cabin.

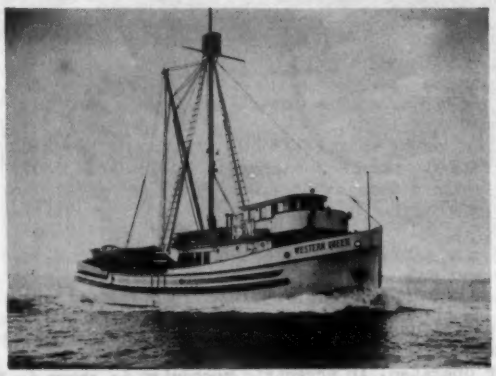

FIGURE 26.—Larger class of sardine and tuna seiner.

If the Jeff Davis had been 75 feet in length, with the 18-foot beam carried well aft, and even if allowance were made for the same liberal forecastle and engine room, the capacity

below deck should be approximately 260 M. As over 20 per cent of the 34 foot long fish hold would be forward of the vessel's midpoint, the improved weight distribution would permit carrying at least 40 M of menhaden on the deck. Further improvements would result if the forecastle and forward fish hold bulkheads were staggered. The additional length would permit a larger deck house and accommodations for 6 or more men. If desired, a corner of the galley, as shown in Figure 25, could be allotted for lavatory facilities.

The builder of the Jeff Davis estimated that a 75 foot vessel could be built for $30,000. However, in view of the probable necessity for heavier construction and for a larger engine, the cost of a 75 foot vessel might well be over $35,000.

All experience during the progress of the work indicated that the shrimp trawler hull with the transom stern is a versatile type suitable for operating a Pacific type purse seine. When the vessel was loaded, the transom stern did not create undue drag, the normal nine-knot cruising speed was reduced by only one knot. The butt ends of the planking at the stern should be protected by a lead or sheet iron strip or hardwood to absorb the chafing occasioned by the skiffs and loaded vessels coming along side. The transom stern should be double or triple planked to assure sufficient strength and tightness when the vessel is loaded.

A guard from the skeg to the horn timber is essential to prevent the netting from tearing on the skeg and rudder when the menhaden strike the net during the pursing operation and while hauling. The several types of guards which were tried are discussed in the section entitled "Log of Operations". The guard which proved successful was constructed of 1 3/8-inch square wrought iron (Figure 27). The brace shown between the horn timber and the guard was installed to minimize the vibration induced by the propeller stream. No guard was necessary around the propeller, for when one blade was down, the entire propeller was well outside the line of netting from the side of the vessel to the skeg. Marks were made on a shaft coupling to locate and adjust the position of the blade after the net had been set. If the main engine clutch does not have a positive neutral, a brake must be used to prevent the propeller from turning during the pursing operations.

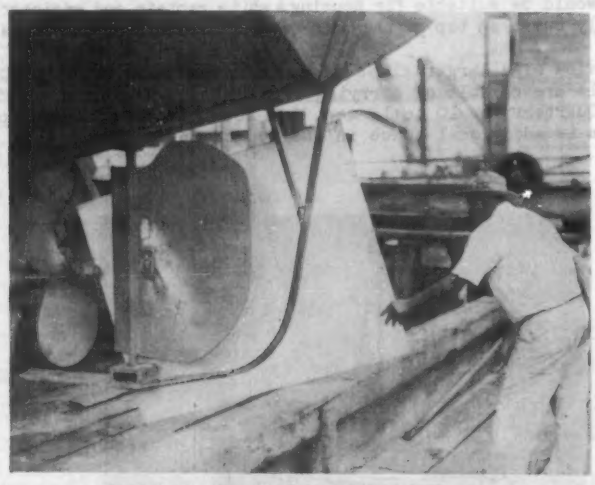

FIGURE 27.--Guard from horn timber to skeg.

At least one large centrifugal pump of 3-inch inlet-discharge is essential to remove the water admitted to the hold while bailing fish and from leakage. The diaphragm deck pump should also be power operated. An eccentric mechanism is shown in Figure 7 for applying power to the lift pump. The intakes for these pumps should be located in a well just ahead of the shaft log as this is the low point of the vessel when loaded. The lazaret must be provided with a positive drain, preferably a 2 or 3-inch pipe, to the well. Some provision

for drainage or pumping the engine room and forecastle sections must also be made. By using a stuffing box on the propeller shaft and by proper construction, the bulkhead can be made water-tight and the engine room protected from leakage of fish hold bilge water.

The hatch on the Jeff Davis was 6 feet wide by 8 feet long. This is considerably larger than those normally installed on shrimp vessels but it is the minimum practical size when seining for food fish. A 6 feet by 8 feet hatch is too small to admit the menhaden unloading conveyor and provide the working space and head room to which the shoveler is accustomed. It is estimated that the minimum size of a menhaden seiner's hatch should be 10 feet square unless more efficient unloading methods are employed. If individual judgment should deem this too large for shrimping, one of the hatch covers could be provided with a small or "booby" hatch. A canvas cover, cut to fit around the small hatch coaming, could be made for the entire hatch. This would permit using only the small hatch for stowing and icing shrimp and the canvas cover would insulate and seal the remainder of the hatch.

Deck Equipment

Topside steering and engine controls are essential for purse seining from the main vessel, and are advantageous whenever special maneuvering is necessary. Without the unrestricted view thus provided, it would be difficult to find the fish, to determine the characteristics of the schools, or to set the seine. The topside controls of the Jeff Davis are shown in Figure 28. The clutch-control and engine speed-control shafts extend from the topside through the vessel wheelhouse and terminate in the forecastle where they were connected with appropriate linkage to the engine. Connection between the topside steering wheel and that in the wheelhouse was obtained by two sets of bevel gears and shafting. One set of bevel gears transferred the horizontal rotation of the topside steering-wheel shaft to a vertical shaft passing through the top of the house. A second set of bevel gears transferred rotation of the vertical shaft to the horizontal shaft of the wheelhouse steering gear.

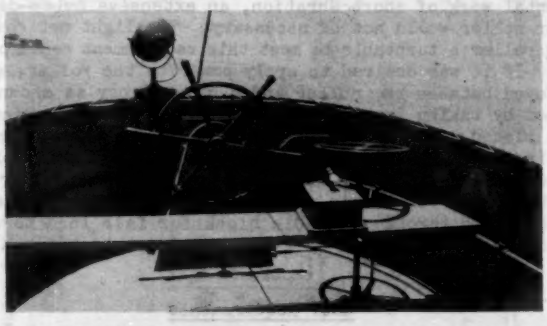

FIGURE 28.--Topside steering and engine controls.

The type of winch used for pursing and lifting is shown in Figure 4. This is one of a number of similar types of standard equipment used for this purpose. Figure 22 shows a recent development in pursing winches which incorporates a cable drum for bailing fish and strapping in heavy seines.

When purse seining for menhaden with a larger vessel, the "tom" weight must be much heavier than that used with the two purse boat method. The present purse weights are 250 to 400 pounds, while that on the Jeff Davis weighed nearly 600 pounds. During periods of rough weather or when unusually heavy schools of fish were surrounded, the increased pursing strain tended to lift the "tom" weight and the pursing operation had to be momentarily stopped to allow the weight to sink. A heavier "tom" weight of 800 to 1,000 pounds could be used to overcome this difficulty. A small davit resembling a purse boat davit as shown in Figure 20 should be more practical for handling a weight of this size. Brackets could be welded to the boat type davit to accommodate the purse blocks. The superstructure imposed on a standard Pacific Coast type davit tended to render it somewhat unstable with the 600 pound "tom" weight.

A vessel operating a menhaden seine should be equipped with a gypsy on the bow and a lead block to power purse that section of the cork line. The stern pursing can be accomplished by installing a lead block on the corner of the table over the stern and leading the line to a winch gypsy through a rail block. By this method, the cork line can be pursed as rapidly as the bottom line, if so desired, by only two men. After the power pursing has been completed, it would be the function of the seine skiff and striker-boat men to secure the cork purse rings to their skiffs and back haul the purse lines to have them in proper order for hauling. At times when the stern of the vessel was toward the sun, the menhaden exhibited a tendency to work in that direction. This carried the net beyond the vessel's stern and bunched the seine near the fair lead, thus increasing the labor involved in hauling. By attaching the corks on the last half of the seine to the striker boat, it should be possible to improve the lead, as the position of the striker boat could be controlled by ropes.

For temporary exploratory seining operations for food fish, makeshift arrangements to provide two pursing gypsies can be made on the present shrimp winches. The normal shrimp winch has only one gypsy, but a second one can be installed by substituting a longer shaft for one of the other cable drum shafts and mounting a gypsy at the end as shown in Figure 29. The gypsies should be at least 18 inches apart and the extended shaft steadied by a bearing and bracket bolted to the deck. If space arrangements permit, it would be desirable to locate the gypsies on opposite sides of the winch. A cable from one of the trawl drums could be used to raise the "tom" weight.

Most of the larger shrimp vessels could be adapted to seining for food fish and have sufficient capacity without alterations below deck. In addition to the winch changes and topside steering, the only additional vessel requirements would be a turntable and adjustable boom guys. The latter are very simple to install and require only the use of shorter cable straps and two sets of blocks and tackles in place of the long cables and turnbuckles normally used to fix the lateral position of the boom. It is possible to strap the seine aboard as explained in the "Log of Operations" section and thus avoid the use of the turntable, but this would be unduly time-consuming in operating the light net which would suffice for food fish. For experimental work of short duration, an extensive below-deck driving mechanism to operate the power roller would not be necessary. The light net could be pulled by hand over a free turning roller; a turntable to meet this requirement could probably be constructed for less than $200. If it was desired to apply power to the roller, an endless twist-link chain could be employed between the roller and a winch gypsy as shown in Figure 29. This could be accomplished by taking 1½ turns of chain around the roller and directing the chain through two sheaves placed on the table or in the side of the table, depending on its outline. When the turntable is in the hauling position, the sheaves and turns of chain on the roller should be on the side toward midships. Two steel pins with pipe rollers should be placed to guide the chain on the power roller and prevent its fouling. After leaving the turntable, the chain could be directed through a double block for fair lead to a gypsy. Tension on the twist-link chain could be governed by a block and tackle between the fair lead block and the rigging.

Gear Requirements

Through years of practical experience, commercial fishermen have evolved standardized types of purse seines for various fisheries. The gear for each fishery has individual characteristics dependent on the type of fish, their activity when surrounded and the general conditions under which the seine is operated. The Pacific Coast pilchard seine is designed for use off the large vessel and for fish having a strong tendency to "sound" and thus submerge the net when surrounded. The pilchard's greatest attempt to escape is made after the net is pursed. The Atlantic Coast menhaden seine is designed for use from two small motor boats and for capture of a fish having a strong tendency to escape in a horizontal direction. The menhaden's greatest attempt to escape is made while the net is being pursed.

It is rare if ever that a purse seine on the Pacific Coast is hung with more than twelve fathoms of netting to ten fathoms of cork line, as fullness is not needed and would only increase the expense of the gear. Another characteristic of these seines is their great length. Only the Alaska salmon seine, the size of which is limited by law, is 200 fathoms or less in length. Puget Sound salmon seines are nearly 300 fathoms long; California pilchard seines are generally hung 250 to 275 fathoms long and tuna seines are usually in excess of 350 fathoms in length. Menhaden seines are rarely over 170 to 180 fathoms in length and

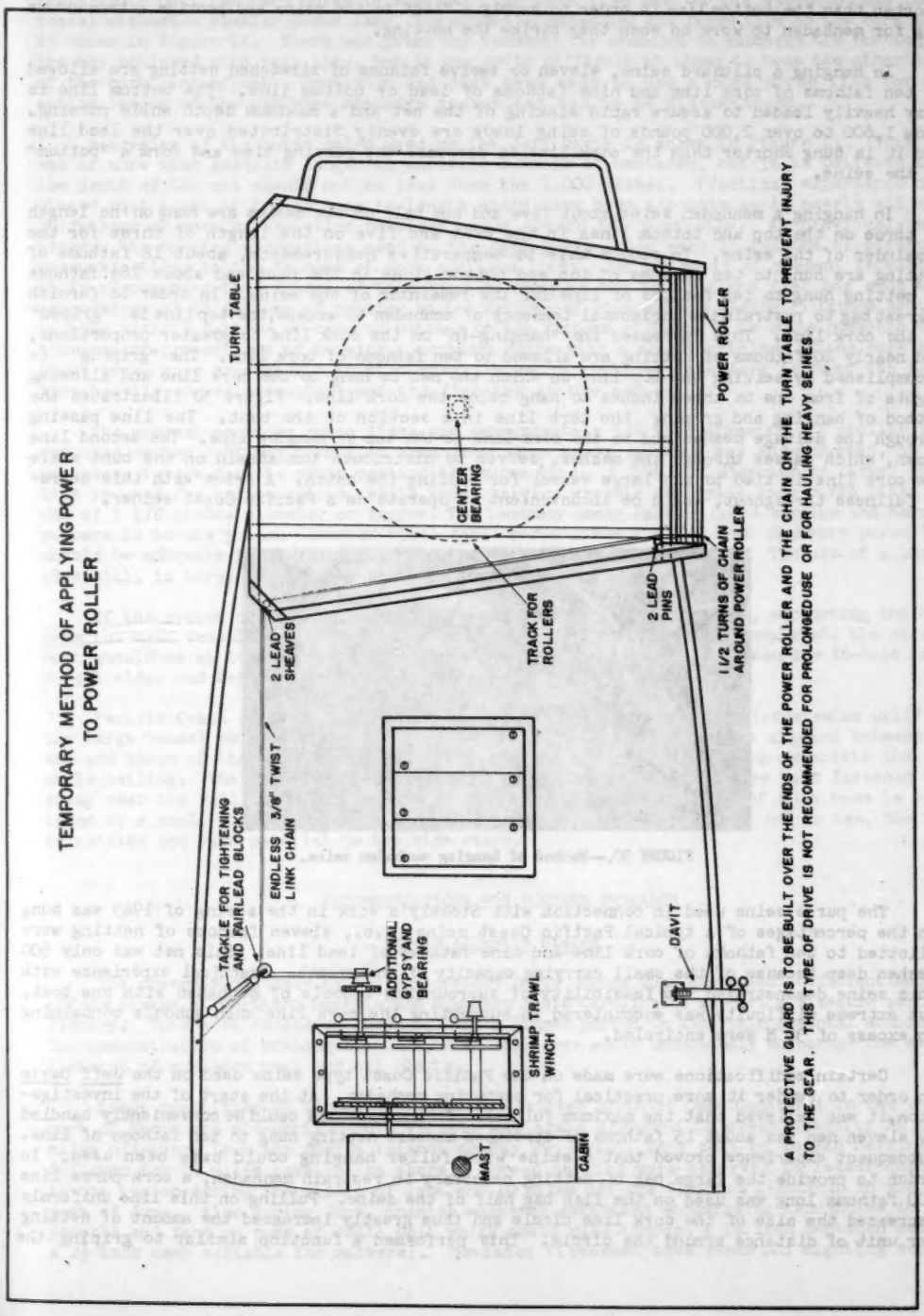

FIGURE 29.--Deck arrangement for temporary exploratory seining.

even shorter ones are quite common. These seines are hung quite full and the cork line is shorter than the bottom line in order to supply a "top" to the seine and provide a tremendous bag for menhaden to work on when they strike the netting.

In hanging a pilchard seine, eleven or twelve fathoms of stretched netting are allowed to ten fathoms of cork line and nine fathoms of lead or bottom line. The bottom line is very heavily leaded to assure rapid sinking of the net and a maximum depth while pursing. From 1,600 to over 2,000 pounds of seine leads are evenly distributed over the lead line and it is hung shorter than the cork line to decrease the pursing time and form a "bottom" to the seine.

In hanging a menhaden seine, about five and one half or six meshes are hung on the length of three on the top and bottom lines in the bunt and five on the length of three for the remainder of the seine. To reduce this to comparative measurements, about 18 fathoms of netting are hung to ten fathoms of top and bottom lines in the bunt and about 16½ fathoms of netting hung to ten fathoms of line for the remainder of the seine. In order to furnish a great bag to restrain the horizontal tendency of menhaden to escape, the top line is "griped" to the cork line. This increases the "hanging-in" on the cork line to greater proportions, and nearly 20 fathoms of netting are allowed to ten fathoms of cork line. The "griping" is accomplished by seizing the top line on which the net is hung to the cork line and allowing bights of from one to three inches to hang below the cork line. Figure 30 illustrates the method of hanging and griping the cork line in a section of the bunt. The line passing through the selvage meshes and to the cork line is the top or hanging line. The second line shown, which passes through the meshes, serves to distribute the strain on the bunt while the cork line is tied to the large vessel for bailing the catch. A seine with this degree of fullness throughout, would be inconvenient to operate on a Pacific Coast seiner.

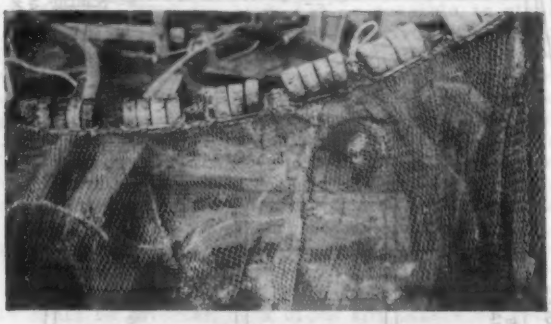

FIGURE 30.—Method of hanging menhaden seine.

The purse seine used in connection with Stokely's work in the spring of 1943 was hung on the percentages of a typical Pacific Coast seine: i.e., eleven fathoms of netting were allotted to ten fathoms of cork line and nine fathoms of lead line. This net was only 600 meshes deep because of the small carrying capacity of the vessel. Practical experience with this seine demonstrated the feasibility of surrounding schools of menhaden with one boat, but extreme difficulty was encountered in supporting the cork line when schools containing in excess of 30 M were encircled.

Certain modifications were made on the Pacific Coast type seine used on the Jeff Davis in order to render it more practical for capturing menhaden. At the start of the investigation, it was believed that the maximum fullness of hanging which could be conveniently handled by eleven men was about 15 fathoms of stretched measure netting hung to ten fathoms of line. Subsequent experience proved that a seine with fuller hanging could have been used. In order to provide the large bag of netting necessary to restrain menhaden, a cork purse line 100 fathoms long was used on the fish bag half of the seine. Pulling on this line uniformly decreased the size of the cork line circle and thus greatly increased the amount of netting per unit of distance around the circle. This performed a function similar to griping the

net as practiced in the menhaden fishery. By means of this pursing device, two men in the skiff could pull far more corks in a given time than five men on the stern of the large vessel without a similar purse line. The method of attaching the purse line to the cork line is shown in Figure 12. There was never any tendency for menhaden to submerge the portion of the net equipped with this line, but it was quite difficult at times to keep the other half of the cork line afloat. Provision had just been made to use a cork purse line for the entire length of the net when menhaden operations had to be discontinued.

A drawing of the purse seine used on the Jeff Davis is shown in Figure 11. This net was of more than adequate length to encircle schools of menhaden, but it is believed that the depth of the net should not be less than the 1,000 meshes. Practical experience disclosed that a net of 180 fathoms in length would have been adequate as in nearly all sets 20 fathoms or more of the seine remained unset aboard the turntable. As previously mentioned, the hanging proportions used on the Jeff Davis seine were 15 fathoms of stretched measure netting to ten fathoms of cork and lead lines. On the basis of present knowledge, it is recommended that seines of this type be hung on the hauling and fish bag ends with proportions of 15 fathoms of netting to ten fathoms of line and the middle 75 fathom section be hung with 18 fathoms or more of netting to ten fathoms of line. It is quite possible that the present proportions of hanging a menhaden seine with a slight griping of the cork line might prove more practical. In this case, it would still be necessary to have the float line heavily corked throughout and the fish bag at one end.

The present menhaden purse lines are approximately 5/8 inch diameter. A similar line was used on the Jeff Davis but, on occasions when heavy pursing was encountered, it was necessary to use care to avoid parting the purse line. A 7/8 inch diameter or larger purse line is used for salmon seines, while those sardine vessels employing rope purse lines use one of 1 1/8 inches diameter or larger. The tendency among Pacific Coast sardine and herring seiners is to use ½ inch diameter steel cable purse lines. A 7/8 inch diameter purse line should be adequate for pursing the comparatively light menhaden seine. The use of a larger line will, in turn, require the use of a larger "tom" block.

If the system of bailing, common to the menhaden fishery, that is, supporting the bunt from the main vessel and the two boats as shown in Figure 16, is contemplated, the striker boat should be at least a foot wider and somewhat higher on the sides than the 16-foot long, 5-foot wide, and 2-foot high striker boat used on the Jeff Davis.

Pacific Coast sardine practice is to support the fish bag by the large seine skiff and the large vessel while bailing. Sufficient cork line and netting are allowed between the bow and stern of the seine skiff and the vessel to form a square to accommodate the fish while bailing. The position of the skiff is maintained by an auxiliary boom fastened to a strap near the rail and between two side stays. The vertical angle of this boom is regulated by a small block and tackle suspended from the mast collar. When not in use, the boom is hoisted and lays parallel to the side stays.

RECOMMENDATIONS FOR FURTHER RESEARCH

South Atlantic States

The observations made by the exploratory party during June disclosed sufficient menhaden off the coasts of Northern Georgia and Southern South Carolina to support a sizeable menhaden fishery. This area should be observed over a longer period to ascertain seasonal abundance. The demonstration of prolonged abundance in this area would undoubtedly encourage the establishment of menhaden meal and oil plants.

Large quantities of thread herring were observed north of Cape Canaveral in the latter part of March and mid-April. This variety was again observed in great quantity 10 to 15 miles off-shore from the Amelia Islands on May 29, 1944. This belt of thread herring was followed for 15 miles parallel to shore. Thread herring were observed in lesser quantity in the region during the middle of June and 10 miles off the Savannah Lightship in the last part of June. Also during June, Spanish mackerel exhibited encouraging tendencies to form schools and feed on pods of small bait which would pass through a 1½ inch menhaden mesh or a 2½ inch mesh suitable for mackerel. Menhaden fishermen have reported sighting schools

of Spanish mackerel at some distance off-shore during the middle and late summer. These fish were sighted on occasions when menhaden could not be found on the shoals. The fishermen have been discouraged from looking for mackerel as the plant and vessel owners have been primarily interested in menhaden. W. W. Anderson,Service aquatic biologist,who participated in the shrimp exploration of the Fish and Wildlife Service Pelican off Florida, Georgia and South Carolina, reported sighting schools of Spanish mackerel and capturing individuals on runs from 20 to 70 miles off-shore. In order to develop these fisheries, sufficient exploratory fishing must be performed to accumulate data demonstrating the abundance and economic soundness of the fishery.

Sea bass, groupers,and snappers, which are normally taken by hand lines, did not appear too plentifully off the Atlantic Coast of Florida. These were generally found in very small spots on or near uneven bottom. These spots of fish are quite difficult to locate and it is doubtful if a trawl could be successfully used to capture them. A type of hoop net operated by a wire cable winch has recently been developed at New Smyrna, Florida, which is quite successful for sea bass. Investigation should be conducted to study the use of similar equipment on other reef-like grounds, for their use might stimulate production.

A hand line fishery for king fish exists off the lower East Coast of Florida. A modification of the type of commercial salmon trolling gear used on the Pacific Coast should be tested for capturing these and other members of the mackerel-like fishes. (However, this type of gear would not be substantial enough if large sharks were encountered.)

Quantities of sharks were frequently observed about schools of menhaden and following shrimp trawlers discarding waste fish. During certain seasons the sharks attack the shrimp trawl fish bag and cause damage to the net and loss of the catch. In view of our present vitamin A shortages, exploratory fishing should be undertaken to establish the seasonal areas of abundance and the optimum technique for capturing sharks. At present, a shark fishery exists at Salerno, Florida, and it is probable that greater production could be obtained if the mechanics of gear operation were improved.

Gulf Coast

Prior to initiating the expedition, many persons on both coasts of Florida and in the Gulf region were questioned regarding their observations of schooled fish. An analysis of their reports leads to the belief that the Florida Keys are a winter ground for Spanish mackerel, and that a migration exists along both coasts of Florida in the south and north directions during the fall and spring respectively. Apparently the migration strikes the shallow waters at Cape Canaveral on the Atlantic Side and the Tarpon Springs region on the Gulf Coast. A counter spring migration also appears to exist; the fish leave the coast at Cape Canaveral and the St. Petersburg area in the Gulf. A summer fishery exists out of Panama City, Florida, while sponge fishermen operating out of Tarpon Springs have reported sighting mackerel many miles to seaward during August and September. Handline fishermen out of Naples, Florida, have reported seeing spots of color 20 to 30 miles offshore, during the summer, that were believed to be Spanish mackerel. The waters there are too deep for effective use of their shallow gill nets, which are regularly used in coastal waters. Members of the crew of the Jeff Davis who had fished out of Cameron,Louisiana, in 1943 reported sighting schools of Spanish mackerel in that area. Mr. Gordon Gunter of the Texas Game, Fish and Oyster Commission,in a paper on the unutilized Fishery Resources of Texas, mentions reports of schools of Spanish mackerel 5 miles long and 3 miles wide! According to this report,the fish are migrating in a northerly direction. Spanish mackerel are taken by sport fishermen in Louisiana and Mississippi during the summer months. In addition, Lt. Don Simon, a Naval Flyer with fishing experience, has reported sighting many schools of fish during patrol flights outside the Mississippi delta.

All these sources of information indicate a major potential food resource which is undeveloped because of a lack of knowledge of purse seine gear and its operation. A few menhaden seiners operate in the Gulf of Mexico, but their operations are confined to inland waters or those very near to shore. Also, the plant operators do not desire to have their equipment fish for mackerel as they are primarily concerned with menhaden.

Of additional significance is the fact that Spanish mackerel are known to occur off Venezuela during the summer. These fish would be within the range of modern Pacific type seiners based at some American port in the Gulf of Mexico.

Profitable fisheries for menhaden exist at Apalachicola, Florida, and Pascagoula, Mississippi. The fish at Pascagoula are taken entirely from inside waters, and no attempt is made to fish in the open Gulf. Menhaden also occur in the inland waters of Georgia during the summer, but these groups constitute only a small portion of the Fernandina catch as fish are far more abundant outside. Menhaden are reported in tremendous abundance out of Cameron, Louisiana.

It is reported that a menhaden plant was operated in the northern part of Texas, but became a financial failure after World War I. It was reported that fish were plentiful, but that the cost of production was too high. Since that time, considerable improvement has been effected in both fishing methods and reduction plant equipment.

Menhaden are a prolific fish on the Atlantic Coast and their presence has been definitely established at three widely separated locations in the Gulf of Mexico. In view of the tremendous production of menhaden in other areas, it is logical to assume that a resource for many more reduction plants exists in the Gulf of Mexico. Knowledge of the best fishing grounds and the abundance of fish obtained by exploratory fishing would lead to the development of the Gulf fisheries.

Sharks are reported by Mr. Gunter to be quite plentiful off Texas. It was reported that sharks were so plentiful off Apalachicola during parts of the 1944 menhaden season that they seriously interfered with fishing operations. Little information is available as to the vitamin A potency of southern sharks, but extreme variation even among similar species is indicated. Exploratory fishing would yield knowledge of the best shark fishing grounds and fishing methods, and thus lead to the utilization of these fish. A fishery for shark would tend to remove predatory fish and increase the supply of other fish useful to man.

The coastline from Mexico to Apalachicola is nearly the same length as that of our Western States which produce nearly half of the total poundage of our continental catch of fish. The states of Texas, Louisiana, Mississippi, and Alabama should welcome the development of fisheries as a means of postwar employment for their people. The Federal Government could materially contribute to postwar employment in the Gulf Region by exploratory fishing.

LOG OF FISHING OPERATIONS

The object of this exploratory fishing study was to investigate the possibilities of purse seining for food fish during the period from January through June in areas not now exploited off the South Atlantic states and to determine if a shrimp-type vessel could successfully fish for menhaden with a modified Pacific-type purse seine operated by a crew of 11 men. The laws of Florida prohibited purse seining for food fish within three leagues of shore (10½ miles), but there were no restrictions off Georgia and South Carolina.

The vessel and gear were complete and ready for operation on January 9, 1944. Shrimp trawlers at New Smyrna reported that large schools of menhaden showing good color were plentiful as far south as Cape Canaveral during December and early January, when calm weather had been experienced for several days. Strong northwest to northeast winds prevented consistent fishing activities from January 9-18. The vessel was at sea three days of this period but no signs of fish were observed from Sapelo Sound to Tall Pines. Weather conditions, except for a few days, were more favorable during the remainder of January. On January 25 after searching for two days, a few flipping menhaden were sighted twelve miles E x N from New Smyrna Beach, Florida. The seine was set around an area exhibiting about five scattered flipping fish and 25 M fish were taken. Probably an equal quantity of fish escaped as the cork line was submerged for a short time while pursing. Nearly three hours' time was required to complete the set and the crews' inexperience with the method of operating the gear was a contributing factor toward the loss of fish. On the following morning, isolated menhaden were observed from shore to ten miles off and at a distance of nearly eight miles both north and south of New Smyrna. No concentration of fish which would warrant setting

was found and there arose a fresh easterly wind which prohibited fishing. That night while running to Fernandina, all lights but the side and shielded top light were periodically extinguished. During these periods, the presence of many small schools of small fish judged to be menhaden were observed by the phosphorescence they caused. These schools were observed from Tall Pines to Fernandina at a distance of five to eight miles off shore. Their presence could not be detected until the vessel ran directly over the school and all attempts to make the fish "show" or flash phosphorescence by hammering on the deck were futile. Because of the difficulty of making the fish show and the small size of the schools, it was questionable if night fishing would be possible during that period. However, these observations and the possibility that the fish would school near shore indicated that fish might be obtained out of Fernandina with improvement of the weather. For this reason and also because of the everpresent possibility of having to face a January northeaster on the normal 12-hour return run with fish from New Smyrna to market at Fernandina it was decided to fish near the latter port. The expected schooling of the fish did not occur and no signs of fish were observed during daylight hours on various runs between Sapelo Sound and St. Augustine.

After the first of February, no market was available for menhaden--the reduction plant closed for the winter--and according to all available information, the possibility of successfully seining for food fish in the areas where it would be permitted was quite remote. Therefore, it was decided to suspend operations and conserve funds for a more promising period.

The set made off New Smyrna in January indicated that greater buoyancy or a striker boat was needed to support the cork line and that the corks should be pulled more rapidly on the fish bag end by the skiff men. Also a larger seine skiff was needed for bailing the fish. To provide additional buoyance, 50 "montara" bags were attached to the cork line.

CROSS SECTION AND SIDE VIEW OF MONTARA TYPE FLOAT

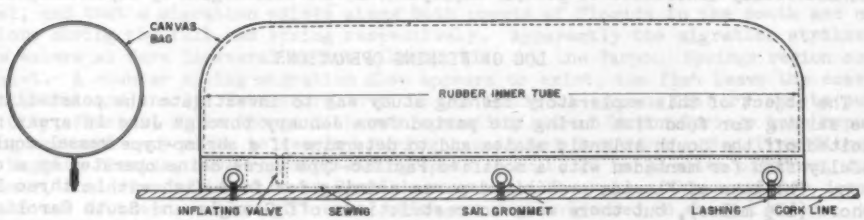

FIGURE 31.--Montara type float.

These bags, shown in Figure 31, consisted of a cylindrical canvas tube, closed at the ends, provided with grommets for attaching to the cork line and a rubber inner tube with an inflating valve. Also during February the fish bag half of the cork line was equipped with a hand purse line, as shown in Figure 12.

Operations were again resumed on March 6, 1944. The vessel operated out of Fernandina until March 11 but weather conditions were quite unfavorable for the appearance of pelagic fishes. Consequently the major portion of time was spent in reef fishing.

TABLE 3 - RECORD OF SETS - JANUARY 25 TO MAY 25, 1944

VICINITY	DATE	STAGE OF TIDE*	DIRECTION CURRENT	DIRECTION WIND	DEPTH IN FATHOMS	TIME OF SET	PURSING TIME	HAULING TIME	BAILING TIME	TOTAL TIME	ESTIMATED SIZE OF SCHOOL	CATCH	REMARKS
							MIN.	HRS MIN	MIN.	HRS MIN	M**	M**	
9 MILES OFF NEW SMYRNA BAR	JAN 25	F	N	E	14	4:05 PM	30	1:45	30	2:45	50	25	FISH SUBMERGED CORK LINE AND ESCAPED.
1/2 MILE EAST OF NEW SMYRNA BAR	MAR 15	F	N	S	2	8:00 AM	15	1:05	10	1:30	5	5	SET MADE ON SCATTERED FLIPS TO OBTAIN BAIT.
1/2 MILE OFF NEW SMYRNA BEACH	MAR 26	E	N	S	2	10:50 AM	15	-:55	10	1:20	150	75	NET TORE ON SHOE--FISH ESCAPED.
14 MILES " " " "	APR 11	F	N	E	15	7:40 AM	15	-:40	05	1:00	-	***	SET ON SCHOOL OF BAIT WITH MACKEREL SHOWING.
1/2 MILE OFF DAYTONA BEACH, FLA.	APR 20	E	N	SW	3	7:30 AM	15	1:15	-	1:30	150	-	SPLIT FISH BAG--WHILE DRYING UP FISH WITH TACKLE
1/2 " " " " "	APR 20	F	N	SW	2½	2:05 PM	15	1:20	10	1:45	20	20	SCHOOLS HAD SPLIT UP.
1/4 " " " " "	APR 21	E	N	NE	2	8:05 AM	20	1:15	20	1:55	150	60	NET FOULED AND TORN BY PURSE LINE--FISH ESCAPED.
1/4 " " " " "	APR 26	F	N	SW	2	7:20 AM	20	-:50	10	1:20	80	15	FISH LOST OVER CORK LINE--VESSEL SHORT HANDED.
1/4 " " " " "	APR 26	H	N	SW	2	10:30 AM	15	1:-	20	1:35	85	15	FISH LOST OVER CORK LINE--VESSEL SHORT HANDED.
1/4 " " " " "	APR 26	E	N	SW	2	1:40 PM	15	1:20	10	1:45	80	15	FISH LOST OVER CORK LINE--VESSEL SHORT HANDED.
1/4 " " " " "	APR 27	F	N	SW	2	8:20 AM	20	1:15	30	2:05	80	80	USED SKIFF AT MIDDLE OF NET--NO FISH LOST.
1/4 " " " " "	APR 27	E	N	W	2	11:30 AM	15	1:15	30	2:00	200	30	TORE WEB ON SHOE, LOST FISH--INSTALLED SHOE AND RUDDER GUARD.
1 MILE SOUTH ST. AUGUSTINE SEA BUOY	MAY 4	E	N	SW	2½	9:05 AM	15	-:50	20	1:25	15	15	SET ON FLIPS--NO FISH LOST.
10 MILES " " " " "	MAY 4	F	N	E	2	1:25 PM	12	-:30	-	-:42	20	-	LET FISH GO AS WIND CARRIED BOAT TOO CLOSE TO BEACH.
12 MILES NORTH DAYTONA BEACH	MAY 5	E	N	E	2	10:00 AM	20	-:50	45	1:55	500	60	FISH SUBMERGED CORK LINE AND ESCAPED.
2 MILES OFF CUMBERLAND ISLAND	MAY 16	F	N	SW	2½	10:45 AM	25	2:00	25	2:50	23	23	PURSE LINE FOULED IN NETTING--NO FISH LOST.
2 MILES NORTH AMELIA ISLAND	MAY 16	H	N	SE	3	3:15 PM	60	1:20	-	2:20	20	-	NET BADLY FOULED ON BROKEN RUDDER GUARD--WIND TOO STRONG.
1/4 MILE OFF AMELIA ISLAND	MAY 17	E	N	SW	1-2/3	7:40 AM	20	1:10	40	2:10	100	60	NET TORE ON BROKEN GUARD--FISH LOST THROUGH HOLE.
1/4 " " " "	MAY 17	F	N	SW	1-2/3	11:10 AM	20	-:55	40	1:55	100	50	NET TORE ON BROKEN GUARD--FISH LOST THROUGH HOLE.
1/4 " " " "	MAY 17	F	N	SW	2	2:10 PM	40	1:-	15	1:55	20	20	PURSE LINE FOULED WEBBING AND NET TORN ON GUARD.
1/4 " " " "	MAY 18	E	N	SW	3	7:30 AM	35	1:-	25	2:00	75	10	NET TORE ON BROKEN GUARD--FISH LOST THROUGH HOLE
1/4 " " " "	MAY 18	E	S	SW	2	10:05 AM	55	-:40	15	1:50	150	90	NET TORN ON BROKEN GUARD.
1/4 " " " "	MAY 22	E	S	SW	2	8:45 AM	15	-:30	35	1:20	200	55	NET TORE ON BROKEN GUARD AND PURSE LINE FOULED.
1/4 " " " "	MAY 22	E	S	SW	2½	1:00 PM	15	-:45	15	1:15	4	4	SMALL SCHOOL.
1/2 MILE OFF NASSAU BAR	MAY 23	F	N	SW	2½	7:40 AM	15	1:20	-	1:35	20	-	TORE NET 5 PLACES ON BROKEN GUARD--FISH RELEASED
1/4 MILE OFF TALLPINES	MAY 25	F	N	E	1-2/3	9:30 AM	15	-:45	50	1:50	70	70	HAD NEW GUARD INSTALLED--NO FISH LOST. DROPPED ANCHOR TO PREVENT DRIFTING ASHORE.
1/4 " " "	MAY 25	E	N	E	1-2/3	1:30 PM	15	1:30	30	2:15	30	30	NO FISH LOST--DROPPED ANCHOR TO PREVENT DRIFTING ASHORE.

* F - FLOOD TIDE, E - EBB TIDE, H - HIGH TIDE. ** M DENOTES A MEASURE USED IN THE MENHADEN FISHERY AND IS EQUIVALENT TO 640 POUNDS OF MENHADEN. *** 440 MACKEREL, 135 BLUEFISH.

From March 13 to April 22, the vessel was based at New Smyrna as it appeared most probable from past information that pelagic food fish would appear there at an earlier date than in the more northerly regions. Another deciding factor was that hand lining in this area should net an operating return. The first two days were spent in looking for pelagic fish from Fernandina to New Smyrna from shore to 15 miles off shore. On March 15, occasional menhaden were observed flipping for several miles around the New Smyrna Bar. The net was set around a few flips and 5 M menhaden were captured. These fish which averaged 7½ inches in length, were preserved for use as bait in a mixture of ice and salt. The fish remained in good condition for 7 days. Occasional menhaden were showing for a distance of 15 miles south of the bar but no concentrations worthy of setting on were found. The sea had been quite disturbed for several days, and this condition normally tends to split the schools. From March 16-19, runs were made to points from 20 to 25 miles off shore to engage in hand lining for bottom fish. No surface varieties except flying fish were observed the 16th, 17th, and 18th, but on the 19th isolated menhaden were again observed over a large area. The weather from March 20-23 was so severe that even hand lining was not possible. Off shore runs were made to the hand line grounds on March 24-25 without observing surface fish other than occasional menhaden. On March 26 after two days of good weather, numerous menhaden mud-riles, some showing color, were seen close to shore and south of New Smyrna. A set was made on one of the better showings and it was estimated that nearly 150 M fish were surrounded. When the fish struck the netting, a large tear resulted from the netting being stretched over the sharp shoe. Approximately 75 M were saved and about 20 M of these were preserved for bait. On the 27th, it appeared that the favorable weather might hold. The vessel proceeded to Cape Canaveral to prospect for food fish. Approximately 20 menhaden mud-riles were sighted from New Smyrna to a point nine miles south. No fish were sighted on off shore runs, but in the area close to shore, 20 to 30 miles north of Cape Canaveral, large schools of thread herring or "hairy backs" were sighted. Some of these schools appeared to contain more than 200 M fish. On the 28th, 8 schools of Florida bonita were sighted in the area 8 to 15 miles off and SE to S of the Cape Canaveral Shoal Buoy. These fish were moving too fast to surround with a purse seine. During this trip, no Spanish mackerel or bluefish were sighted. On the 29th and 30th, off shore runs to the reefs were again made without sighting fish other than flying fish.

The weather prevented further fishing until April 3 when the vessel was again directed to a reef 23 miles east of New Smyrna Beach. At 5:00 p.m. 2 large schools of Spanish mackerel showed near the boat. Before the anchor could be raised and preparations made for setting, the fish disappeared. Two similar signs of fish were sighted but they also disappeared before they could be reached. The weather on April 4th and 5th was severe but moderated sufficiently on the 6th to permit hand lining. April 7th was spent in a futile attempt to obtain bait. This condition was possibly due to the severe weather of the previous three days. The period, April 8-10, was spent on work necessary for the maintenance of the vessel. On April 11, a single mackerel was sighted in a "pod" of small fish or "bait" 14 miles east of New Smyrna. The spot was surrounded and 440 pounds of mackerel—average weight, 1 pound—and 135 pounds of bluefish—average weight, 3/4 pound—were captured. After this set was completed, a heavy fog rose and further off shore fishing was impractical. A small school of red drum was later encountered one mile off shore and 20 miles south of New Smyrna and a set made to determine their action. The net was set more than 100 yards ahead of the fish but apparently they were traveling too fast and passed under the lead line before it reached bottom. However, approximately 40 M of thread herring, nearly 7 inches in length, were captured. This was quite a surprise as there had been no apparent sign of thread herring. April 12-15 was spent in the Cape Canaveral area. On the southward run, about 15 menhaden mud-riles, some showing slight color, were sighted from shore to three miles off along the 10 mile stretch below New Smyrna. Many large schools of thread herring were sighted near shore between 17 and 11 miles north of Cape Canaveral. Two runs were made off shore for a distance of 12 miles during the southward trip without sighting fish. April 13, 14, and 15 were spent in reef fishing and making various runs off shore for distances of 30 miles between Cape Canaveral and Sebastian, Florida. The only surface fish sighted, except flying fish, were one mackerel, one sail fish, and several pods of bait.

A market for menhaden was now available and the period from April 20 through May 25 was spent in menhaden fishing. On the morning of April 20, many large schools of menhaden, all showing good color, were observed off Daytona Beach. A set was made, the school successfully surrounded and the net pursed, but the seine was entirely too heavy to haul by

hand. The net was hoisted or "strapped" aboard by placing a strap around the net and lifting with the single whip. On the last lift, the 9-thread webbing in the fish bag parted and the fish escaped. It was estimated that the school contained well in excess of 150 M. After the net had been repaired, only small schools of menhaden could be found that afternoon. One of these was surrounded and 20 M were captured. On the following morning, the seine was set around a very large school of menhaden. The fish completely and thoroughly tangled the net; however, 60 M were saved. It was obvious that the net must not be set on such large schools of fish until the method of operation became more familiar to the crew.

While running to Fernandina that night, all but the running lights were again periodically extinguished. As before, many schools of small fish were located by phosphorescence between St. Augustine and Fernandina at distances of 3 to 8 miles off shore. During a period of one hour of the run between Tall Pines and Mayport at a distance of approximately 5 miles off shore, a bunch of fish was sighted nearly every minute! The bunches of fish observed that night were much larger and nearer the surface than those observed in January. The phosphorescence of several of the larger groups could be seen over 100 yards from the vessel by stopping the vessel and setting the propeller in motion. These observations indicated that night fishing might be practical during this period. The difficulty would be that if the vessel passed directly over the school, it would follow the vessel and not remain in position for a set. Fishing results out of Fernandina were not encouraging and the vessel again proceeded south. Some concentrations of small fish were observed off Tall Pines and occasional menhaden were observed all along shore to New Smyrna. It appeared that the violent weather of the two previous days had caused the schools to break up and possibly send them to deeper water. On April 26, three sets were made off Daytona Beach on schools of menhaden estimated to contain 80 to 100 M. The vessel was short handed and no one was available to operate the striker boat. Consequently the cork line was submerged on all three sets and the average catch was only 15 M per set. The following morning with a full crew, the first set yielded 80 M. The seine was set a second time around a school estimated to contain 150 to 200 M. After the net was pursed, the wind and tide turned the vessel so that it was between the sun and the net. The net was badly torn on the shoe and only 40 M were saved which were bailed on deck. Due to shrinkage caused by heat and weight much of the fish was lost on the run to Fernandina.

Originally, a guard, made of 2 parallel pieces of 3/4-inch pipe bent to clear the rudder, was welded to each side of the skeg and bolted to the horn timber. This guard was dislodged by the vibration of the propeller stream. It was decided to smooth the skeg rather than install another guard when the vessel was dry-docked in February. Most Pacific seiners do not need a guard around the rudder and this smoothing precaution would seem sufficient to prevent further tearing of the net. Practical menhaden experience, however, demonstrated that protection was necessary; so the vessel was dry-docked and a guard made of 1-inch diameter cold-rolled steel installed.

On May 3, the vessel operated out of Fernandina, but only a few isolated fish were seen. The next day, a set made off St. Augustine on a flipping school, showing no color, yielded a catch of 15 M. A second set was made 10 miles south of St. Augustine on a small spot of color. Approximately 20 M could have been bailed, but the fish were released because of the danger of drifting ashore as the wind was quite strong from the east. On the morning of May 5, the wind was of moderate force from the east accompanied by a heavy sea. Probably a hundred schools of fish, all showing good color and estimated to contain 75 to 150 M each, were observed along shore north of Daytona Beach within a distance of 20 miles. When these spots were approached with the boat, they moved so close to the breakers that it was impossible to set on them. One very large bunch of fish, believed to contain 500 to 1000 M, was observed about 1/4 mile off shore. While the seine was being set, the fish dashed in all directions, many going under the boat and seine. When the circle had been completed and both ends of the seine taken aboard, nearly the entire net was submerged by the fish. Of this group of fish, 60 M were saved. The net was hauled under conditions that would have resulted in severe tears had no guard been provided for the rudder and shoe. Therefore, it was assumed that the principle of the guard was successful. The period from May 8-13 was spent searching for fish between Fernandina and New Smyrna. The wind during this period was moderate to strong easterly, and no menhaden were sighted.

After installing the rudder guard, a moderate vibration was noticed in the stern while the vessel was under way. This vibration ceased on May 12 and subsequent experience led to

the conclusion that the guard, made of 1 inch diameter cold rolled steel, was lost on that date.

On May 15, the vessel operated south of Fernandina. No menhaden were sighted but two schools of Florida bonita were observed off Nassau Bar which could easily have been surrounded with the net. On May 16, a set was made off Cumberland Island which yielded 23 M menhaden. The net was torn on the broken guard and probably some fish were lost. A second set, made north of the Fernandina Jetty, resulted in no catch as the net and purse line were fouled on the broken guard and rudder. A set made on May 17 off Amelia Island around a good show of flipping fish yielded a catch of 60 M. The net suffered two tears from the stern and fish were seen escaping. A second set netted 50 M but many fish escaped through two large holes. The net was again torn on the third set which yielded 20 M. On May 18, a school estimated to contain 100 M, was encircled but only 10 M were saved because of a purse line foul and three large holes. A subsequent set resulted in a catch of 90 M although many fish were lost through a large hole. May 19-21 were spent in repairing the gear. On May 22, a school of fish estimated at 150-200 M was encircled but only 55 M were saved because of holes in the net. After the damage had been repaired, another set was made on a rather poor show of fish which netted 4 M. The following day a set was made on a small body of fish off Amelia Island. Five very large holes were torn in the webbing while hauling. Approximately 20 M could have been bailed but the fish were released. As dry-docking facilities were available the next day the catch did not warrant remaining in Fernandina until evening to unload.

A rudder and skeg guard made of 1 3/8-inch square wrought iron was installed and braced as shown in Figure 27. This guard was substantial enough to withstand the vibrational strains induced by the propeller stream and other stresses as there was no indication of deterioration after a month's running.*

On May 25 moderate easterly weather was experienced and most of the bunches of fish were too close to shore to enable setting. Finally, at a safe distance off shore, a school was located which yielded 70 M. The second try netted 30 M. Both of these sets were made under unfavorable conditions as the vessel had to be anchored while hauling to prevent drifting ashore. This caused practically the entire net to be dragged over the guard; yet no tearing resulted. After unloading this fish, the shovelers at the plant stated that they would no longer unload the vessel. Their reasons for this stand were that the hatch was too small to provide full freedom of motion when the conveyor was in place and the hold was of insufficient height to stand fully erect.

The information thus far collected demonstrated beyond question that schools of menhaden could be successfully surrounded by a purse seine operated from the main vessel. The chief problem remaining to be solved was the loss of tremendous quantities of fish through holes caused by the net tearing on the skeg. A minor difficulty was experienced in preventing submersion of the cork line when schools of over 100 M were encircled. Those on the expedition firmly believed that the final heavier rudder guard and the use of the purse line along the entire cork line would have solved these problems. Attempts were made to obtain a market to fully demonstrate the worth of these improvements in order that the equipment might be tried in other localities. However, the plant operators believed that the general shortage of help throughout the industry would result in unloading difficulties similar to those experienced in Fernandina. Therefore, it was decided to use the vessel for the remainder of the period to search for food fishes and carry only a sufficient crew to operate the vessel.

The exploratory activities were confined to the region between St. Augustine, Florida, and St. Helena Sound, South Carolina, and to a distance of 40 miles off shore. This area was prospected several times during June. As many of the days were uneventful, the discussion will be limited to those worthy of note. Wherever runs were made close to shore under favorable weather conditions, numerous large schools of menhaden were observed particularly north of St. Simon Sound. On May 28, 30, 31, the vessel was used in cooperation with Naval personnel in testing a shark repellant. A trip to a point 40 miles east of Amelia Island was made on May 29. A most interesting observation was of over 75 schools of thread herring in the body of water between 10 and 15 miles offshore. The average size of these schools was estimated to be between 150 and 200 feet across. This belt was followed for a distance of 15 miles parallel to shore and still many schools could be seen in the distance. No larger fish were seen feeding in these schools. After leaving the herring, signs of

* In May 1945 the guard was still in excellent condition after many months of shrimp trawling.